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BY

JOSEPH GRINNELL

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A NEW POCKET GOPHER FROM SOUTHEASTERN CALIFORNIA

BY

JOSEPH GRINNELL

(Contribution from the University of California Museum of Vertebrate Zoology)

Six adult specimens of pocket gophers collected by me in 1920 in the vicinity of the Providence Mountains, extreme eastern San Bernardino County, California, have remained unsatisfactorily identified until a recent effort of mine to draw up ranges for all the gophers so far described from California. This effort necessitated critical reëxamination of various lots of specimens, with the result that the lot in question could not satisfactorily be allocated with any named series. The natural course in such case is to name and describe the refractory lot; and furthermore, the peculiarities shown so uniformly by the six specimens appear to be correlated significantly with geographic occurrence.

Thomomys providentialis, new species

Providence Mountains Pocket Gopher

Type.—Breeding female, skull and skin; no. 31450, Mus. Vert. Zool.; Purdy, 4500 feet altitude, 6 miles southeast of New York Mountain, Providence Range, San Bernardino County, California; April 26, 1920; collected by J. Grinnell; orig. no. 5249, J. G.

Diagnosis.—A *Thomomys* of, perhaps nearest, the "*perpallidus* group" (see Bailey, 1915, pp. 33, 68–80). Size small; ear very small; general coloration moderately dark for occurrence in an arid habitat; skull relatively smooth and light, and teeth small; spread of zygomatic arches narrow, with "spread" anteriorly much less than posteriorly—thus presenting the opposite condition from "square"; rostrum weak and narrow and nasals short; bullae rather small and globular. Sexes apparently not greatly dissimilar in size or in skull characters.

Measurements.—See accompanying table; comparisons can be made with the figures given by Bailey (1915), by Grinnell (1921, 1926 *b*, c), by Hall (1930), and by Burt (1931).

Distribution.—In so far as known, only the vicinity of the Providence Mountains, in eastern San Bernardino County, California. Two localities are represented by the specimens examined: Purdy, 4500 feet altitude; and the pumping station, 3000 feet, 3 miles north of Leastalk.

Comparisons.—In external appearance, *Thomomys providentialis* resembles most closely *perpes* Merriam; this is true of size, and of coloration both above and below save for greater amount of black about the ears and face; the exceedingly small ear is here a definite differential character; indeed, in this matter of small ear the species here newly described seems to stand apart from any other species of California or Nevada. The coloration is darker than in average *mohavensis* Grinnell, and of a different tone from that in either *amargosae* Grinnell or *perpallidus* Merriam, lacking the ashy of the latter and the yellow tendency of the former.

The six skins of *providentialis*, taken April 25 to 27, show some variation among themselves in color tone and in texture of pelage. Molt-lines are shown distinctly in four of them, whereby it is clear that transition from a darker, fluffier, winter pelage is under way to a brighter or paler, shorter and satiny-surfaced pelage. No. 31451, the darkest colored of the lot, appears to be entirely yet in winter pelage (save for a spot on the middle of the back), while in no. 31450 the molt has progressed so that only the rump and flanks still show the winter coat, the balance of the animal showing new bright pelage.

The six skulls are strikingly uniform in all essential characters; any one of them, male or female, when compared with randomly selected examples from any other series of southwestern gophers, as far as I have tried, instantly leaves no doubt as to its racial identity.

Cranially, *providentialis* is nearest like *scapterus* Elliot (series from type locality); differences are: the former has more incurved incisors, more inflated (globular) bullae, less evenly and roundly spreading zygomatic arches, longer nasals, premaxillary tongues reaching not so far behind posterior tips of nasals, notch in posterior end of nasals not so deep, braincase narrower, no trace present of any interparietal fontanelle, occipital condyles less backward projecting.

Taking, now, the skull of *providentialis* as basis of comparison, the skull of *perpallidus* (series from type locality) differs in greater size, in more projecting incisors, in heavier molars, in larger but less globular bullae, in much more widely and squarely spreading zygomatic arches, in heavier maxillary portion of zygomatic arch (especially at juncture with jugal), in much more prominent ridges on braincase, and in much longer nasals and rostrum.

The skull of *mohavensis* (either sex, topotypes) differs from that of *providentialis* in being of larger size, more angular and ridged, zygomatic arches more squarely spreading, all the teeth larger, bullae larger but less globular, nasals longer, and rostrum in general heavier.

The skull of *perpes* (series from type locality) as compared with that of *providentialis* is of heavier build, it is more ridged and angular, its interorbital width is greater, the rostrum is heavier, all the teeth are larger, the incisors are more incurved, the bullae are less globular, the interpterygoid notch is U-shaped instead of narrowly V-shaped.

The skull of *amargosae* (topotypes) differs from that of *providentialis* in much greater size (with much greater difference in mass between the sexes), in larger teeth, heavier rostrum, much larger but less globular bullae, and much more squarely spreading zygomata.

The skull of *operarius* Merriam (topotypes) differs from that of *providentialis* in an extreme degree of massiveness throughout, this shown conspicuously in heaviness of rostrum, greater interorbital width, and greater mastoid breadth; the teeth are heavier, the zygomatic arches more squarely spreading, the auditory bullae though larger, less rounded.

The skull of *centralis* Hall (topotypes) differs from that of *providentialis* in much longer rostrum, including nasals and premaxillaries, in more squarely spreading zygomatic arches, in closer approach to one another of parietal ridges, in larger teeth, and in less smooth and globular bullae.

The skull of *canus* Bailey (topotypes) differs from that of *providentialis* in much greater size and general massiveness, in greater amount of ridging especially in supraoccipital region, in more squarely spreading zygomata, in more nearly U-shaped rather than sharply V-shaped interpterygoid notch, in less globular even though larger bullae, and in far more massive teeth.

In selecting features for mention in the above comparisons of skulls, only outstanding, "key" differences are given. For example, when the rostrum in one race is notably heavier than it is in the other race under consideration, then that fact suffices for mention, even though the describer might add that the nasals and premaxillaries are wider, the rostrum deeper, etc. But when the shape of the nasals is different, such as shown in relative tapering or notching, then this is given mention as a separate character. Nearly every one of the cranial characters above designated can be verified from the accompaning illustrations (plates 1 and 2). These have been arranged so as to facilitate critical comparisons.

General remarks.—The pocket gopher now named from the Providence Mountains area is, it will be seen, set off sharply by cranial

characters from each of the nearest-lying, desert-valley races, *amargosae, perpes* and *mohavensis*. Significantly, it is nearest like the species *scapterus* of the Panamint Mountains area, which lies some 120 miles to the northwest, with lesser ranges and desert valleys interlying. Whether or not these intervening mountains and valleys possess gophers is not known. Nor is the situation with respect to the Charleston Mountains and valleys and other mountain masses of southern Nevada known to me. Nevertheless, the above facts would seem to indicate one of two conditions—that *providentialis* is a "dwarfed" and otherwise modified mountain form, of direct derivation from the gopher stock of former wide distribution over the desert floor, or that its immediate ancestry was with an upland stock from which *scapterus* also was derived. I lean to the latter view, assuming that in former times montane conditions for gopher existence were more continuous along the eastern border of California than now.

The question continually is suggested by workers in non-systematic zoology as to the relative permanence through series of generations of such characters as are used above to diagnose the different races of pocket gopher. I would again (see Grinnell, 1926 *a*, p. 261) stress the case of the Rancho La Brea gophers ("Pleistocene") whose skulls look to me to be identical with those of the race living in the same neighborhood today.

I have here selected a female for typeship and have made comparisons of females with females rather than of males with males. This I have done because of increasing conviction that in *Thomomys* the female is the sex that in cranial features shows specific and subspecific characters with most conservatism; that is to say, males, with growth of the individual, are carried in certain features beyond the stage of expression of purely inherent characters—with advanced age they outgrow specificity. If this be true, then it is not proper to rely on differences shown between males, especially in those cases (as apparently in *providentialis*) where the male never becomes much different from the female and where the old male greatly exceeds the old female in not only size but in ridging and angulation (as in *amargosae*). To repeat: to compare males of, say, *providentialis* and *amargosae* is not as safe for finding true phylogenetic characters as to compare females of those races. Although showing all the true differences, I believe, that males show, these differences even though often exhibited in lesser degree are not so likely to be veiled by those other features that may come in with greater emphasis with advanc-

MEASUREMENTS, IN MILLIMETERS, OF ADULT SPECIMENS OF *Thomomys providentialis*, FROM EASTERN SAN BERNARDINO COUNTY, CALIFORNIA

M. V. Z. No.	Sex	Locality	Date (1920)	Total length	Length of tail	Hind foot	Ear from crown	Weight (in grams)	Basilar length of Hensel	Greatest length of nasals	Zygomatic breadth	Mastoid breadth	Width of rostrum at middle	Least inter-orbital breadth	Alveolar length of upper molar series
31447	♀	Leastalk	April 25	199	65	28	3	101.0	29.9	12.2	20.6	18.1	7.4	6.3	8.0
31448	♀	Leastalk	April 25	197	61	26	3	96.5	28.9	12.6	20.5	18.2	7.1	6.5	7.1
31449	♀*	Purdy	April 26	180	55	25	3	99.3	29.1	11.2	20.0	17.7	7.0	6.5	7.0
31450	♀†	Purdy	April 26	205	65	27	3	114.3	29.2	11.0	21.7	18.1	7.1	6.9	7.3
31451	♂	Purdy	April 27	197	70	27	4	105.2	31.1	12.6	22.6	18.9	7.8	7.2	7.9
31452	♂	Purdy	April 27	185	61	25	3	97.5	29.0	11.7	21.6	18.3	6.9	6.2	7.1

* Contained 4 embryos.
† Contained 6 embryos.

ing age in the male sex. In other words, the student must look more sharply for differences in comparing skulls of females; but he thereby escapes the danger of imputing to races features of ontogenetic nature.

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Transmitted August 24, 1931.

EXPLANATION OF PLATES

PLATE 1

Dorsal views, not retouched or routed out, of adult skulls of nine species or subspecies of the "*Thomomys perpallidus* group" of pocket gophers. All photographed and reproduced natural size.

a, ***Thomomys perpallidus centralis*** Hall; ♀, no. 41684, Mus. Vert. Zool.; Baker, White Pine County, Nevada; May 28, 1929; E. R. Hall.

b, ***Thomomys perpallidus perpes*** Merriam; ♀, no. 16856, Mus. Vert. Zool.; Lone Pine, Inyo County, California; April 14, 1912; H. A. Carr.

c, ***Thomomys operarius*** Merriam; ♀, no. 16810, Mus. Vert. Zool.; Keeler, Inyo County, California; April 29, 1912; H. A. Carr.

d, ***Thomomys perpallidus perpallidus*** Merriam; ♀, no. 16509, Mus. Vert. Zool.; Palm Springs, Riverside County, California; February 11, 1912; J. Grinnell.

e, ***Thomomys providentialis***, new species; ♀, type, no. 31450, Mus. Vert. Zool.; Purdy, near Providence Mountains, San Bernardino County, California; April 26, 1920; J. Grinnell.

f, ***Thomomys scapterus*** Elliot; ♀, no. 26451, Mus. Vert. Zool.; Hanaupah Cañon, Panamint Mountains, Inyo County, California; May 15, 1917; J. Dixon.

g, ***Thomomys perpallidus oanus*** Bailey; ♀, no. 41645, Mus. Vert. Zool.; Deep Hole, Washoe County, Nevada; May 12, 1929; E. R. Hall.

h, ***Thomomys perpallidus amargosae*** Grinnell; ♀, no. 26476, Mus. Vert. Zool.; Shoshone, Inyo County, California; May 9, 1917; T. I. Storer.

i, ***Thomomys perpallidus mohavensis*** Grinnell; ♀, no. 4647, Mus. Vert. Zool.; Victorville, San Bernardino County, California; January 1, 1905; J. Grinnell.

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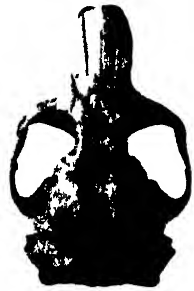

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PLATE 2

Ventral views, not retouched or routed out, of adult skulls of nine species or subspecies of the "*Thomomys perpallidus* group" of pocket gophers. All photographed and reproduced natural size.

a, ***Thomomys perpallidus centralis*** Hall; ♀, no. 41684, Mus. Vert. Zool.; Baker, White Pine County, Nevada; May 28, 1929; E. R. Hall.

b, ***Thomomys perpallidus perpes*** Merriam; ♀, no. 16856, Mus. Vert. Zool.; Lone Pine, Inyo County, California; April 14, 1912; H. A. Carr.

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f, ***Thomomys scapterus*** Elliot; ♀, no. 26451, Mus. Vert. Zool.; Hanaupah Cañon, Panamint Mountains, Inyo County, California; May 15, 1917; J. Dixon.

g, ***Thomomys perpallidus canus*** Bailey; ♀, no. 41645, Mus. Vert. Zool.; Deep Hole, Washoe County, Nevada; May 12, 1929; E. R. Hall.

h, ***Thomomys perpallidus amargosae*** Grinnell; ♀, no. 26476, Mus. Vert. Zool.; Shoshone, Inyo County, California; May 9, 1917; T. I. Storer.

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SYSTEMATIC REVISION AND NATURAL HISTORY OF THE AMERICAN SHRIKES (LANIUS)

BY

ALDEN H. MILLER

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SYSTEMATIC REVISION AND NATURAL HISTORY OF THE AMERICAN SHRIKES (LANIUS)

BY

ALDEN H. MILLER

(Contribution from the Museum of Vertebrate Zoology, University of California)

CONTENTS

INTRODUCTION

The chief object of the present undertaking has been to conduct an inquiry into the speciation of a geographically variable and hitherto unsatisfactorily known race-group of American birds. Correlative studies of structural variations, geographic distribution, and life-history have proved essential to an adequate interpretation of speciation. I was led to select the American shrikes, genus *Lanius,* because they met the conditions just specified and because of the accessibility of materials and facilities for the study of this group. The group, also, by reason of its relatively incipient subspecies, provides special opportunities for gaining a knowledge of the early stages of racial differentiation.

Up to the time when William Palmer (1898) adequately defined the three subspecies of Loggerhead Shrike (*Lanius ludovicianus*) inhabiting the eastern United States, the nearly complete lack of uniformity in the treatment of these races was a constant source of dissatisfaction to ornithologists. Palmer's work gradually has found acceptance although the geographic boundaries and characters of these races required additional study. Among the shrikes of the western United States, Ridgway described *Lanius ludovicianus gambeli* from central California (1887, p. 529) and *L. l. mearnsi* from San Clemente Island (1903, p. 108). However, Linton (1908*b*, p. 182) and others subsequently doubted the existence of the latter form. Similarly, *L. mexicanus* of Brehm (1854, p. 145) has not been widely recognized as a valid subspecies of *L. ludovicianus.*

More recently Oberholser, in his descriptions of *L. l. nelsoni* (1918, p. 209) and *L. l. grinnelli* (1919, p. 87) from Lower California, has added much to the knowledge of western Loggerhead Shrikes; he did not complete the study of the other races of the species which he at one time contemplated. Some ornithologists have entertained doubts concerning the existence of separately recognizable Lower Californian forms such as Oberholser described.

In like manner, controversy has been extant regarding the name *invictus* proposed by Grinnell (1900, p. 54) for the Alaskan population of *Lanius excubitor,* and disagreement has existed between European and American students as to the validity of *Lanius borealis* as a full species.

With these problems in mind, an attempt is now made to determine dependable means of characterizing the subspecies of American shrikes. Statistical studies, by reason of a sufficiency of material, at least in some forms, and an adherence to small geographic units, have produced results in addition to those obtained by Strong's statistical treatment of *L. ludovicianus* (1901). However, the assemblage of loaned collections, which has been available, has shown color distinctions which are difficult of detection in a small series of skins.

The extensive and, for the most part, fragmentary literature relating to the natural history of American shrikes has been sought out, and all the important papers found have received attention. Birds as common and as spectacular in behavior as our American shrikes receive mention in a variety of minor publications dealing with natural history. It has not proved practicable to search for all such references to members of the group.

On the whole the published accounts of shrike behavior emphasize the abnormalities. An especial effort to ascertain and record the average or usual activities of these birds has been made throughout the present study. For example, the study of reactions associated with territory, for the most part non-spectacular and accepted as commonplace, has yielded, I feel, especially worthy results.

MATERIALS

Skins of 2083 American shrikes, 205 *L. excubitor* and 1878 *L. ludovicianus*, have been assembled by loan, or were present either in the California Museum of Vertebrate Zoology or in my personal collection. The necessary alcoholic specimens, young birds, and embryos have been secured during numerous trips into the field while in search of information on natural history. Continuous field observations in July and the first week in August, 1929, at various localities in the San Joaquin Valley and the Mohave Desert, California, and bi-weekly, or more frequent, excursions to the vicinity of Pinole, Contra Costa County, California, from January through May in 1930, have supplied most of my personal notes concerning natural history. During 1928 and 1929, however, numerous short trips in search of shrikes, conducted in all months of the year, were made to various parts of California. Previous to 1927 when this study was commenced, I had opportunity to note shrikes and their habitats in parts of Oregon and Nevada, extreme southeastern California, and on Santa Catalina and Santa

Cruz islands, California. In the spring of 1929 a group of seven young *L. l. gambeli* was taken from the nest and a part of this brood successfully raised, one bird surviving until December, 1930. In the spring of 1930 a single juvenile was raised to maturity.

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I wish to express appreciation of aid rendered through the loan or donation of skins by the following: Dr. Louis B. Bishop; Major Allan Brooks; Mr. Charles D. Bunker, of the University of Kansas Museum of Birds and Mammals; Dr. R. V. Chamberlin, of the University of Utah; Mr. B. W. Cartwright; Mr. Donald R. Dickey; Mr. Ralph Ellis, Jr.; Professor Junius Henderson, of the University of Colorado; Mr. Stanley G. Jewett; Mr. J. Eugene Law; Mr. T. T. McCabe; Dr. Loye Miller; Mr. G. Frean Morcom; Mr. John R. Pemberton; Mr. Paul G. Redington, of the United States Bureau of Biological Survey; Mr. Harry S. Swarth, of the California Academy of Sciences; Mr. P. A. Taverner, of the National Museum of Canada; Mr. W. E. Clyde Todd, of the Carnegie Museum; Dr. Alexander Wetmore, of the United States National Museum; Mr. George Willett, of the Los Angeles Museum of History, Science and Art; and Mr. Owen L. Williams. Dr. Erwin Stresemann and M. Jacques Berlioz have aided in securing information relating to type specimens. Acknowledgment is due to Mr. Lawrence V. Compton for assistance in obtaining photographs; to Mr. Griffing Bancroft for unpublished information regarding the nesting of Lower California shrikes; and to Dr. Jean M. Linsdale and Mrs. Virginia D. Miller for assistance in the handling of notes and manuscript.

The courtesies extended to me at the Museum of Vertebrate Zoology through Dr. Joseph Grinnell and the frequent suggestions and counsel received from him personally have been highly appreciated.

SYSTEMATIC REVISION AND ANALYSIS OF VARIATION

The family Laniidae is essentially an Old World group, approximately thirty-three genera and at least three hundred and fifteen species and subspecies occurring in the Palaearctic region, Africa, Australia, southern Asia, and the East Indies. True shrikes of the family Laniidae are absent altogether from South America, while in North and Central America the family is represented by but two

closely related, although entirely distinct, species, both belonging to the genus *Lanius*. Of these two species, *Lanius excubitor* is of more northern distribution, its breeding range not overlapping, or even approaching closely, the breeding range of the more southern species, *Lanius ludovicianus*. *Lanius excubitor* occurs widely in the Palaearctic region, and is represented by numerous geographic races in the Old World. In North America, however, only two races occur, *borealis* and *invictus*. *Lanius ludovicianus*, an exclusively New World species, is divided into eleven subspecies, in the chronological order of their description as follows: *ludovicianus* (the subspecies), *excubitorides*, *mexicanus*, *gambeli*, *migrans*, *anthonyi*, *mearnsi*, *nelsoni*, *grinnelli*, *sonoriensis*, and *nevadensis*. The species *ludovicianus*, represented by these races, occurs roughly from coast to coast of North America and from southern Canada to the Isthmus of Tehuantepec in Mexico.

Discussion of Characters

In commencing a systematic study of the American Laniidae it seems advisable first to list and discuss the various specific and subspecific characters with particular reference to their usefulness in the taxonomy of this group and to the variation displayed as a result of sexual and age differences subsequent to the juvenal plumage. Only external characters have been investigated in the present study, although the internal structures doubtless would have shown significant features. A number of the characters here mentioned have proved to be of little importance in taxonomy and consequently have been analyzed only far enough to show their true value. An arbitrary classification of characters has been adopted merely to facilitate their treatment.

COLORATION

Many of the colors of shrikes cannot be described adequately by means of a color key such as that offered by Ridgway (1912). Ridgway's terminology will be employed, however, with only such departures from his names as seem unavoidable. It is not deemed practicable to attempt a quantitative analysis of color. Strong (1901) attempted this for the Loggerhead Shrikes but encountered difficulties which prompt one to carry his method no farther.

UNDER PARTS

The coloration of the under parts is a difficult character to deal with. The color tones aside from the color of the vermiculations vary among the several races from pure white to either pallid neutral gray, light drab, or wood brown. The feathers readily acquire adventitious color tones which on first inspection are not easily detected as abnormal. Thus confusion may easily follow and render impracticable the identification of subspecies by means of this character alone. In races in which the under parts are not pure white, the females average darker beneath than do the males, but the difference is so slight as to be of no value in serving to distinguish the sexes with any degree of assurance.

Of more importance than the sexual variation is the variation due to age. In all American forms there is a tendency for the under parts to be darker in first-year birds as compared with birds two years old or older. This applies most particularly to the vermiculations, but also to the ground color of the under parts. In races such as *sonoriensis* and *excubitorides*, first-year birds, as regards this character, are often indistinguishable from adults. In *borealis, invictus, nevadensis, nelsoni,* and *mexicanus,* and to a lesser degree in *migrans* and *L. l. ludovicianus,* first-year birds average darker than adults. On the other hand, in *gambeli, grinnelli,* and *anthonyi,* in which the under parts are dark in adults, no certain difference is to be seen between first-year and adult birds. A study of these last-named races formed the principal basis for a tentative conclusion (Miller, 1928, p. 407) to the effect that no difference in first and second-year body feathers could be observed in *L. ludovicianus*. For the sure separation of first-year from adult birds the condition of the wing feathers has been employed, particularly the presence or absence of juvenal greater primary coverts, as previously described (*loc. cit.*).

A peculiar color effect is produced in the under parts of the species *ludovicianus* during the growth of the first-year plumage owing to the fact that the breast feathers which first break out of the sheaths are darker than the feathers grown later in the same molt. This peculiarity has been observed in skins of molting birds and in living birds kept in captivity. The first fall birds of this species taken in August or September, therefore, may appear decidedly darker than the first-year birds taken in winter. In addition to this change in the type of feather grown, there is the possibility of a slight fading

of the dark-colored feathers during the late fall. In any case, the end result in winter first-year birds is a coloration which is little different from that of adult birds although the similarity in the two plumages is closer in some races than in others.

Age differences in *L. excubitor* are more marked than in *L. ludovicianus*. A series of first-year *L. excubitor* shows an extraordinary range of seasonal and individual variation. This is caused partly by a more extensive prenuptial molt than is found in *L. ludovicianus* but

Fig. 1. California Loggerhead Shrike (*Lanius ludovicianus gambeli*) in the flesh showing first-year plumage in which juvenal, buff tipped, greater primary coverts, alula, and rectrices are present. Collected at La Grange, Tuolumne County, California, December 10, 1915; Mus. Vert. Zool., no. 26323.

also by the great amount of brown on the under parts, this color, apparently, being more given to fading than are the other colors of the breast.

In general, the fading of the pigments in the feathers of the under parts is slight, and, except for *L. excubitor*, the coloration of these regions is little altered until the time of year when the young are being cared for, at which season abrasion of the feather tips frequently makes color comparisons difficult or inaccurate.

Dorsal Surface of Head and Back

The coloration of the back, and of the dorsal surface of the head, furnishes subspecific characters which are more reliable than the coloration of the under parts. As with the ventral coloration, females average slightly darker than males and first-year birds average darker and browner than adults. In *L. excubitor* the first fall plumage is

usually wood brown dorsally in marked contrast to the grays of adults. This brown color is changed sufficiently by wear, fading, and molt during the course of the year so as to bear a close resemblance to the adult coloration at the time of the breeding season.

In *L. ludovicianus* the fading of the dorsal coloration is not marked but is slightly more noticeable than in the coloration of the under parts. Abrasion alters the mass color effect by the removal of the feather tips, which in this species may be either lighter or darker than the more proximal parts of the feathers. In some races, especially in *mexicanus,* the middle portions of the feather vanes are nearly black, thus producing extremely dark-colored spring birds.

Rump and Upper Tail Coverts

The color of the rump area has been used widely by previous writers in characterizing subspecies. The coloration of this area, however, is subject to considerable individual variation and to fading (Palmer, 1898, pp. 251, 252), both factors which limit its usefulness as a key character in separating the various races. When used in connection with other features of coloration and when considered on the basis of averages, the rump is still to be regarded as important. In determining the color of this region, care must be exercised in distinguishing between the color of the feathers of the rump and upper tail coverts and the color effect produced by the reflection of light from the bases of the rectrices beneath. The bases of the rectrices may be either white, gray, or black. Thus, a bird that possesses light gray rump feathers and upper tail coverts may appear to have a white rump patch if the underlying bases of the rectrices are white. The color of the bases of the rectrices is highly variable and of less value than the color of the tail coverts and rump in distinguishing subspecies.

In *L. ludovicianus* age and sexual variations in the rump patch are largely masked by individual variation and by seasonal differences due to fading. However, the rump appears to average slightly lighter in males than in females. Again, as with other regions of the body in *L. excubitor,* the color of the rump during the first year may be widely different from that of the adult. Not uncommonly in this species some juvenal upper tail coverts are retained throughout the first year.

Loral, Orbital, and Auricular Regions

The color of the facial mask is of no value in characterizing subspecies but may be used as a basis for separating the species *L. ludovicianus* and *L. excubitor* in North America. Pronounced age and sexual differences do occur. In adult females of *L. ludovicianus* the lores and preocular region are not pure black as in males but are mixed with gray. In like manner, in the North American representatives of *L. excubitor,* the females show a better development of the white or gray spot beneath the eye than do the males. In first-year birds of both species the preocular region is grayer than in the corresponding adults of the same sex. The first winter birds of *L. excubitor* show the usual extreme variation in the development of the mask, the postocular and auricular regions frequently being hair brown and the antorbital portion of the mask entirely gray rather than black. Some first-year *L. ludovicianus* possess a brown auricular region, particularly the females, yet only a small part of the first-year population, usually birds of small size and those with retarded or excessively incomplete molt, fail to develop the black auricular area. The coloration of the anterior part of the mask is the most reliable, although by no means certain, color distinction serving to separate the sexes in *L. ludovicianus.*

Scapulars

The color and extent of the tippings of the scapulars (humeral tract) furnish a useful character in the definition of some races. The principal difficulty encountered is the ready wearing of the comparatively loose vanes of these feathers, which alteration soon reduces, in a marked degree, the white on their distal portions. No appreciable sexual or age variation is to be noted except in the first fall plumage of *L. excubitor.*

Wing and Tail

The wing coverts, rectrices, and remiges are extremely uniform in color tone in postjuvenal feathers, although there is variation to be considered later as regards size of the white areas. Apparent variation in the color of the tippings of the rectrices and remiges, as well as the black parts of these feathers is due to the varying admixture of juvenal feathers with first-year feathers in first-year individuals. Wing or tail feathers grown during the first fall molt are indistin-

guishable from feathers grown in later molts. In some adult males the black of these feathers seems to be slightly deeper and more glossed than in females and younger males. The white areas are always pure white, untinged with buff, and so distinguishable from most juvenal rectrices and remiges which tend to be buffy or brownish. The first-year dorsal wing coverts are similar to those of the adults except in the first winter plumage of *L. excubitor,* in which the narrow light-colored tippings are frequently drab rather than white or neutral gray. The under wing coverts, axillars, and margin of the wing display no significant variations.

Crural Feathers

It has been found that the feathers covering the tibiotarsus are of some use in characterizing certain races. For example, these feathers in *mexicanus* are usually darker than the adjacent flank feathers. In most instances, however, the crural feathers correspond in color tone with the feathers of the flanks.

Bill, Iris, and Feet

The color of the bill is slightly different in the two species but is entirely constant within each species. In *L. ludovicianus* the bill is entirely black in the breeding season as seen in dry skins, but in the fall and early winter it is frequently brown at the base. In immature fall birds the base of the bill is always brown and occasionally pale flesh color. The black colored areas of bills in dry skins are blackish slate in life except in the breeding season when they are usually pure black.

L. excubitor displays a more definite seasonal variation in bill color, the fall and winter birds always showing definite areas of brown and pale flesh color at the base. The bill is entirely black, even in first-year birds, from April to July. The dark colors of the bill in life are probably similar to those of *L. ludovicianus.*

In so far as can be learned the color of the iris is a dark brown in all of the forms here concerned. The eye color in *gambeli* is not different, at the age of three days when the eyes begin to open, from that of adults. The pupil is not black until about the twentieth day. No sexual difference in the color of the iris is known to me.

The feet vary not at all in color after the period when the young are fully fledged.

MARKINGS AND COLOR PATTERNS

Vermiculations

The term vermiculation is applied to the dark markings occurring on each feather of a region, which in the aggregate produce an irregular, wavy cross-barring of the plumage. Vermiculations may occur on almost all the feathers of the juvenal body plumage. In the later plumages, which are of present interest, vermiculations may occur on the throat, breast, and flanks, and less commonly on the belly and upper and under tail coverts. These markings in postjuvenal plumages are of two types: the one, a sharply defined band of relatively dark color, narrow in width, and the other, a poorly defined, lighter-colored wide band. In both types two bands and an additional dark spot at the base of the vane usually occur on each feather. The first type of vermiculation is characteristic of the breast of *borealis* and *invictus* and of the juvenal plumages of both species, whereas the second type occurs chiefly in postjuveniles of *L. ludovicianus.* There is little chance for confusion of adult or first-year vermiculations with juvenal vermiculations in the species *L. ludovicianus,* provided the pattern of a single feather be examined.

Age and sex variations follow the same plan as does the coloration of the under parts, that is, males and adult birds are less vermiculated on the average than are females and first-year individuals. Soiling tends to enhance the vermiculations, whereas abrasion obscures or removes the distal band on each feather. Nevertheless, the presence or absence of vermiculations is a usable racial character where sufficient skins are available to permit of drawing contrasts between strictly comparable specimens.

Rump Patch

The size and delineation of this area have been made of use in characterizing *mexicanus* (Ridgway, 1904, p. 248); in the adults of this race the patch is extensive and sharply contrasted with the back. Among other races any difference in size or shape of this patch has proved to be unreliable or of only slight value.

EXTENT OF FACIAL MASK

The extent of the black mask across the dorsal base of the bill furnishes a character of reliability as between species but seems to be constant among the races of each species. In *L. ludovicianus* the black on the anteriorly directed feathers at the base of the upper mandible is slightly more extensive in males than in females. In first fall *L. excubitor* the facial mask may not be black in front of the eye; yet the white or gray feathers which occupy this region contrast with the browner feathers of the forehead, thus maintaining the usual outline of the mask.

Posterior to the eyes the mask is broader in males than in females. There are but slight specific and racial differences, however, in its width and posterior extension. *Grinnelli, mexicanus*, and *ludovicianus* (subspecies) possess comparatively extensive black areas on the posterolateral sides of the head.

SUPERCILIARY LINE

The development of a white line along the upper margin of the black mask seems to be associated with the dorsal coloration and appears prominently in races in which the head and back are relatively light-colored. The character varies too much to be of any great value although average differences between races may be noted. The varied manner in which study skins are prepared influences the appearance of this feature.

WHITE AREAS OF PRIMARIES

While measuring the greatest extent of white on the outer primaries, which data will be presented later, I have kept notes concerning the primary on which the white was most extensive. The data thus obtained and subsequent examinations lead me to conclude that no significant variation in the shape of the white area exists. In like manner, no appreciable variation in the tipping of the primaries has been discovered.

WHITE AND GRAY AREAS OF SECONDARIES AND WING COVERTS

Doubtless following Brehm's original description, Ridgway (1904, p. 248) has claimed that the secondaries of *L. l. mexicanus* show more definitely outlined gray areas on the inner web than are to be found on the secondaries of other races of *L. ludovicianus*. I have failed to find this alleged character of any value.

Occasionally in some of the light-colored races of *L. ludovicianus* there is a small basal white area on some of the secondaries. In no case is this marking sufficiently well developed or constant enough to be used as a racial character. In a number of European forms, however, the basal white spot on the secondaries extends beyond the greater secondary coverts and then furnishes a useful character.

The extent of the white tipping on the secondaries and upper wing coverts does vary slightly among the several races but is of little practical value by reason of the small range of variation displayed.

White of Tail

Sketches were made of the proximal outline of the white spot on the tip of the outer rectrix in 1133 specimens. It was hoped that some significant similarity of pattern might be detected among members of a single race. Seemingly the pattern is hereditary inasmuch as siblings usually show a closer degree of similarity than the similarity seen within a group of birds not of the same immediate parentage. In captive birds it was found that the pattern is practically identical for each feather in succeeding plumages. Also, birds of the same locality tend to be more alike than birds from widely separated localities within the range of a subspecies. The heterogeneity which must exist is so great, however, that any one subspecies may show the maximum range of variation in this character. The only instance in which the character appears to be of any use is in the case of the island races, *anthonyi* and *mearnsi*, in which individual variation in pattern is much less than in wide-ranging geographic races. The condition in these island races suggests their establishment by means of a small original stock which, through continual inbreeding, has produced a relatively homozygous isolated group of individuals, displaying characters which in more widely distributed and less isolated forms are of far less constancy.

The occurrence of white or gray at the base of the rectrices has already been mentioned. The development of this marking is so variable as to be of little practical use. There is a tendency for the light-colored races and those with large white areas on the tips of the rectrices to develop this feature extensively, yet the white basal area occasionally may be well defined even in the darkest-colored subspecies. A small amount of white nearly always is present at the bases of the rectrices with the exception of the middle pair.

MEASUREMENTS

In the statistical treatment of definitely measurable variation which follows, the biometric formulas have been used which commonly are employed by geneticists and to a lesser degree by taxonomists and students of geographic variation. The presentation of these formulas by Davenport (1899, p. 13) has been the immediate source for methods used during the present study.

The specimens of *L. ludovicianus* have been segregated into four age groups, namely: (1) adults (second-year or older); (2) first-year birds with outer primaries grown at the first fall molt; (3) first-year birds with outer juvenal primaries retained throughout the first year; and, (4) full-grown juvenal birds previous to the first fall molt. These age groups combined with the sex groupings constitute eight categories into which the collections representing any one race are divided for the purpose of studying mensurable characters. In *L. excubitor* only two age groups are made, adult and first-year. This is possible since all first-year birds retain the complete set of juvenal primaries and consequently do not differ in most measurements from juveniles. Failure so to segregate the age groups has led to indifferent results on the parts of previous workers when subspecies have been compared. The difficulties attending such a segregation by reason of the large number of skins required for study are obvious. Yet, it is felt that there is little gained in a statistical comparison where segregation of groups is not practiced. Because of the number of skins now available some additional data may be derived which it was impossible for Strong (1901) to obtain from his relatively small number of skins. He was further handicapped by the fact that, unknown to him, several races existed within the range of *excubitorides* as it was understood at the time of his writing. Thus, the geographic units which he employed in his comparisons were too large. They included more than one subspecies, and thus they tended to nullify the value of his results.

The present study, by its divisions into age and into small geographic groups must necessarily deal with many groups in which full statistical treatment is impracticable. In these cases only the mean has been derived and the number of individuals used has been indicated so that the averages may be judged accordingly. Also, it has been found that in some races of *L. ludovicianus* there are prac-

tically no first-year birds possessing juvenal outer primaries, whereas in other races of the same species nearly all possess juvenal outer primaries. These differences will be further analyzed under consideration of the problem of molt, but for the present it is clear that all of the age groups outlined above cannot be represented in all of the races. Five populations of the species *L. ludovicianus* have been selected to show variation among the several age groups. These geographic groups are *L. l. ludovicianus, migrans, sonoriensis, gambeli* from the vicinity of San Francisco Bay, and *gambeli* from the vicinity of Los Angeles, California. In all cases birds from areas where intergradation with adjacent subspecies is known to occur were excluded. Likewise, winter migrants from outside of the breeding range of the subspecies were not used. Age and sex variation may be considered to be the same in *L. excubitor* as in *L. ludovicianus* with the few exceptions to be noted later.

Length of Wing

The wing was measured in the customary manner from the wrist to the tip of the primaries, the wing being folded at the side of the body. The right wing was used in all cases.

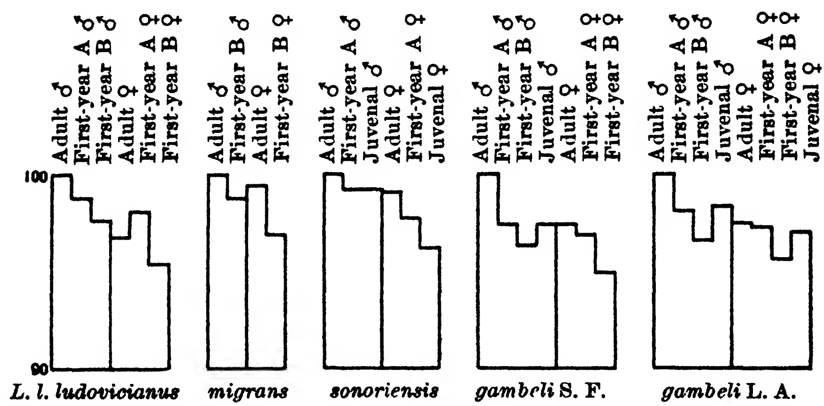

Fig. 2. Diagrams showing sexual and age variation in length of wing in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

Figure 2 shows, by means of diagram, the percentage relationship of the various age and sex groups, taking the adult male as 100 per cent. Table 1 contains the means, and, where possible, the standard deviations, coefficients of variability, and probable errors for the groups represented in the diagrams. It is seen that females average

from 1 to 3 per cent smaller than males when compared within the same age groups. In some instances this difference is no greater than the standard deviation of these groups, but the probable errors serve to show that these differences are reliable, particularly when the same tendency is seen in five separate populations. As might

TABLE 1

SEXUAL AND AGE VARIATION IN LENGTH OF WING

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l. ludovicianus	♂	adult	39	96 98±0 18	1 72±0 13	1 77±0 13
l ludovicianus	♂	first-year, A	26	95 88±0 23	1 77±0 16	1 84±0 17
l. ludovicianus	♂	first-year, B	14	94 75±0 30	1 68±0 21	1 77±0 22
l. ludovicianus	♀	adult	31	93 89±0 20	1 69±0 14	1 79±0 15
l. ludovicianus	♀	first-year, A	11	95 20		
l ludovicianus	♀	first-year, B	6	92 43		
l. migrans	♂	adult	18	98 42±0 24	1 53±0 17	1 55±0 17
l. migrans	♂	first-year, A	19	97 36±0 24	1 58±0 17	1 62±0 17
l. migrans	♀	adult	16	97 83±0 30	1 82±0 21	1 86±0 22
l. migrans	♀	first-year, B	17	95 44±0 32	1 96±0 22	2 05±0 23
l. sonoriensis	♂	adult	36	102 09±0 18	1 66±0 13	1 62±0 12
l. sonoriensis	♂	first-year, A	36	101 13±0 19	1 70±0 14	1 67±0 13
l. sonoriensis	♂	juvenal	10	101 39		
l sonoriensis	♀	adult	26	101 23±0 25	1 89±0 17	1 86±0 17
l. sonoriensis	♀	first-year, A	13	99 93		
l. sonoriensis	♀	juvenal	10	98 26		
l gambeli, S F.	♂	adult	20	99 87±0 28	1 85±0 19	1 85±0 19
l. gambeli, S.F	♂	first-year, A	13	97 33±0 26	1 50±0 19	1 54±0 20
l. gambeli, S.F.	♂	first-year, B	6	96 21		
l. gambeli, S.F.	♂	juvenal	10	97 37		
l. gambeli, S.F	♀	adult	14	97 32±0 24	1 37±0 17	1 40±0 17
l. gambeli, S.F	♀	first-year, A	19	96 80±0 31	2 06±0 22	2 12±0 23
l. gambeli, S.F.	♀	first-year, B.	9	94 80		. .
l. gambeli, L.A.	♂	adult	24	99 62±0 22	1 66±0 16	1 66±0 16
l. gambeli, L.A.	♂	first-year, A	20	97 77±0 26	1 75±0 18	1 78±0 18
l. gambeli, L A.	♂	first-year, B	9	96 28		
l. gambeli, L.A	♂	juvenal	16	97 94±0 28	1 69±0 20	1 72±0 20
l. gambeli, L.A.	♀	adult	22	97 22±0 16	1 16±0 11	1 19±0 12
l. gambeli, L.A.	♀	first-year, A	17	96 69±0 18	1 16±0 13	1 19±0 13
l gambeli, L.A	♀	first-year, B	11	95 34		
l. gambeli, L.A.	♀	juvenal	12	96 64		

S.F.=San Francisco Bay region; L.A.=Los Angeles region; first-year, A=first-year birds in which the outer primaries have been replaced during the first fall molt; first-year, B=first-year birds with all the primaries juvenal (see p. 24).

be expected, first-year primaries grown during the first fall molt tend to be shorter than adult primaries. The difference in these age groups is most pronounced in the male as is best shown in the group *gambeli* from the vicinity of Los Angeles. Where figures are available it would appear that the juvenal wing, in a population taken previous to the first fall molt and after the juvenal primaries are fully grown, is only slightly shorter than the wing grown during the first fall molt.

The birds of the first-year group, however, which retain all the juvenal primaries during the first year are consistently shorter winged than either the juvenal population or the first-year birds with new primaries. It seems proper to conclude, then, that the first-year birds that fail to molt the outer primaries in the first fall molt are a group made up of the small-sized members of the preceding juvenal population. These birds may be looked upon as runts, since in other respects they average smaller than any other age group. They fail to molt perhaps because of lowered vitality and not because they are hatched later in the nesting season.

In *migrans* the group of first-year birds which retain juvenal outer primaries is to be considered in a different light—not as runts. The majority of first-year *migrans* belong to this category and the few birds which do molt the outer juvenal primaries in the first fall may be regarded as the most vigorous birds of that particular season.

The wing length in shrikes is the least variable individually of the mensurable characters and consequently is valuable to taxonomy.

Length of Tail

The tail has been measured from the posterior face of the papilla of the oil gland to the tip of the longest rectrix, usually one of the middle pair but occasionally one of the next adjacent feathers if these latter are longer. The tail is renewed during the first fall molt in at least 60 per cent of the individuals of the species *ludovicianus*. In *L. excubitor* all the juvenal rectrices are retained throughout the first year. In *L. ludovicianus* the number of individuals retaining all the juvenal rectrices usually is so small as to be excluded from statistical comparison. A slight modification of the age groups determined on the basis of the condition of the primaries is used here. These groups are: (1) adults; (2) first-year birds with tails and outer primaries renewed at the first fall molt; (3) first-year birds with renewed tails but with the primaries all juvenal; and, (4) juveniles previous to the fall molt.

Sex and age differences similar to the differences seen in the length of the wing are demonstrated in table 2 and in figure 3, prepared in the same manner as the foregoing diagrams. The adult males tend to be widely separated from the other age and sex groups. As in the case of wing length there is a tendency for less sexual differentiation in

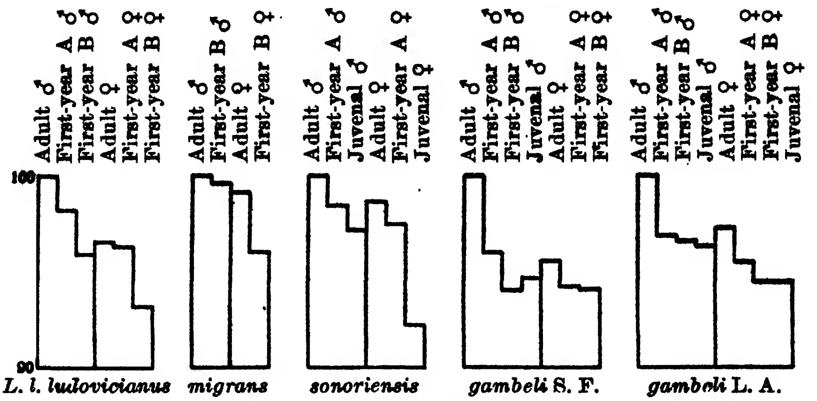

Fig. 3. Diagrams showing sexual and age variation in length of tail in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see tables 1 and 2.

TABLE 2

SEXUAL AND AGE VARIATION IN LENGTH OF TAIL

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l. ludovicianus	♂	adult	44	102.77±0 31	2.99±0.21	2.90±0.20
l. ludovicianus	♂	first-year, A.	24	100.96±0 36	2.63±0.25	2.60±0.25
l. ludovicianus	♂	first-year, B.	10	98.60±0 64	3.04±0.46	3.08±0 46
l. ludovicianus	♀	adult	31	99.37±0.27	2 28±0.19	2 29±0.19
l. ludovicianus	♀	first-year, A.	11	99.09	....	....
l. ludovicianus	♀	first-year, B.	6	95.75	....	....
l. migrans	♂	adult	17	98.25±0.43	2 65±0 30	2 69±0 31
l. migrans	♂	first-year, B.	15	98.03±0.34	1.96±0.24	1.99±0.24
l. migrans	♀	adult	16	97.52±0.42	2.53±0.30	2 59±0'30
l. migrans	♀	first-year, B.	15	94 35±0.38	2.20±0.27	2.33±0.28
l. sonoriensis	♂	adult	32	106.69±0.25	2.17±0.17	2 03±0.17
l. sonoriensis	♂	first-year, A.	37	105.03±0.22	2.00±0.15	1.90±0 13
l. sonoriensis	♂	juvenal	10	103.65	....	....
l. sonoriensis	♀	adult	27	105.35±0.29	2 24±0.20	2.12±0.19
l. sonoriensis	♀	first-year, A.	13	104.11	....	....
l. sonoriensis	♀	juvenal	9	98.46	....	....
l. gambeli, S.F.	♂	adult	19	103.90±0.35	2.27±0.24	2.18±0.23
l. gambeli, S.F.	♂	first-year, A.	14	99 84±0.35	1.97±0 25	1.97±0.25
l. gambeli, S.F.	♂	first-year, B.	5	97.70	....	....
l. gambeli, S.F.	♂	juvenal	9	98.44	....	....
l. gambeli, S.F.	♀	adult	15	99.43±0.34	1.99±0.24	2.00±0.25
l. gambeli, S.F.	♀	first-year, A.	19	97.94±0.43	2.82±0.30	2.87±0.31
l. gambeli, S.F.	♀	first-year, B.	7	97.69	....	....
l. gambeli, L.A.	♂	adult	26	102.26±0.35	2.63±0 25	2.57±0.24
l. gambeli, L.A.	♂	first-year, A.	25	98.18±0.38	2.88±0.27	2.90±0.27
l. gambeli, L.A.	♂	first-year, B.	4	98.90	....	....
l. gambeli, L.A.	♂	juvenal	11	98.54	....	....
l. gambeli, L.A.	♀	adult	28	99.44±0.36	2.57±0.25	2.58±0.25
l. gambeli, L.A.	♀	first-year, A.	21	97.61±0.29	1.97±0.20	2.01±0.20
l. gambeli, L.A.	♀	first-year, B.	6	96.56	....	....
l. gambeli, L.A.	♀	juvenal	11	96.62	....	....

First-year, A = first-year birds in which the outer primaries and all the rectrices have been replaced during the first fall molt; first-year, B = first-year birds in which all the primaries are juvenal but in which at least the central rectrices have been replaced during the first fall molt.

migrans and *sonoriensis* than in *gambeli* and *ludovicianus*. This seeming difference might be due to the random sampling of individuals, yet it may constitute a valid racial distinction; for the two groups of *gambeli* show similarities in this respect suggestive of their close genetic relationship. In comparing the two first-year groups which are separated solely on the basis of the primaries, and which both possess rectrices gained in the first fall molt, it is found that the group retaining all the juvenal primaries possesses shorter tails than does the group with the outer primaries replaced. Juvenal rectrices appear to be of about the same length as the new rectrices of the first-year birds which retain all juvenal primaries.

Although showing a slightly greater coefficient of variability than the wing, the length of tail is a valuable racial character when age groups are properly taken into account.

Length of Tarsometatarsus

The length of the metatarsus has been measured from the heel to the distal edge of the last scale which completely encircles the dorsal surface of the foot. The measurement has proved to be of significance as a character in *borealis*, *invictus*, *L. l. ludovicianus*, *migrans*, and *mexicanus*, but among the other forms it is fairly constant. The difference in the age and sex groups is relatively small, the total range of variation among the averages of the groups being about 2 per cent of the mean. Males tend to be slightly larger than females; this is not, however, entirely true in the figures available for *migrans*. The same age groups have been used here as have been employed previously for wing length except that a comparison of the juveniles has been omitted owing to the difficulty in determining whether or not the metatarsus is fully grown. Although adults tend to have longer metatarsi than first-year birds, particularly the group which retains juvenal outer primaries, it is possible that the slight apparent increase with age is due, not to growth, but to a selective elimination by natural processes of the smaller, runt individuals of the first-year population. In captive birds I could detect no measurable growth of the metatarsus over a period of six months subsequent to the first fall molt.

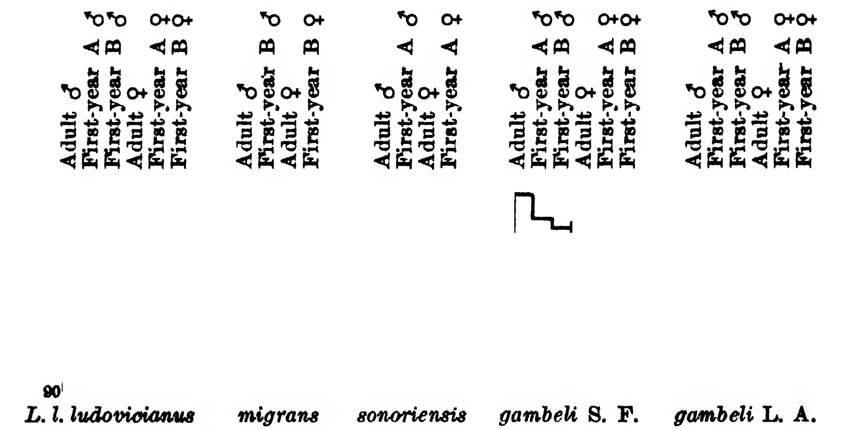

Fig. 4. Diagrams showing sexual and age variation in length of tarsometatarsus in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

TABLE 3

Sexual and Age Variation in Length of Tarsometatarsus

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l. ludovicianus	♂	adult	43	26.83±0 07	.66±0 05	2.45±0 17
l. ludovicianus	♂	first-year, A.	26	26 80±0 10	.78±0 07	2 91±0 27
l. ludovicianus	♂	first-year, B.	14	26 65±0 11	.65±0 08	2 43±0 30
l. ludovicianus	♀	adult	31	26 48±0 08	.66±0 06	2 49±0 21
l. ludovicianus	♀	first-year, A.	12	26 45	....	....
l. ludovicianus	♀	first-year, B.	6	26 40	....	....
l. migrans	♂	adult	18	26 51±0 12	.81±0 09	3 05±0 14
l. migrans	♂	first-year, B.	19	26 71±0 10	.65±0 07	2 43±0 26
l. migrans	♀	adult	16	26 56±0 08	.45±0 05	1 69±0 20
l. migrans	♀	first-year, B.	17	26.50±0.09	.56±0.06	2.11±0 24
l. sonoriensis	♂	adult	38	27.76±0 06	.56±0 04	2.01±0 15
l. sonoriensis	♂	first-year, A.	37	27.77±0.08	.73±0 06	2 62±0.20
l. sonoriensis	♀	adult	28	27.38±0.09	.70±0.06	2.55±0.23
l. sonoriensis	♀	first-year, A.	13	27.52	....	....
l. gambeli, S.F	♂	adult	20	27.7[illegible]±0.10	.66±0.07	2.38±0.25
l. gambeli, S.F	♂	first-year, A.	14	27.41±0.15	.87±0 11	3.17±0.40
l. gambeli, S.F	♂	first-year, B.	6	27.[illegible]	....	....
l. gambeli, S.F	♀	adult	16	27.35±0.14	.87±0 10	[illegible]±0.37
l. gambeli, S.F	♀	first-year, A.	18	27.39±0.11	.70±0 08	[illegible].55±0.28
l. gambeli, S.F	♀	first-year, B.	9	27.10	....	....
l. gambeli, L.A	♂	adult	25	27.39±0 09	.69±0 07	2.51±0.24
l. gambeli, L.A	♂	first-year, A.	27	27.35±0.09	.73±0.07	2.66±0.24
l. gambeli, L.A	♂	first-year, B.	9	27.22	....	....
l. gambeli, L.A	♀	adult	23	27.25±0.09	.61±0.06	2.23±0 22
l. gambeli, L.A	♀	first-year, A.	25	27.17±0.09	.64±0.06	1.52±0.14
l. gambeli, L.A	♀	first-year, B.	11	27.22	....	....

Age groups are the same as those in table 1.

LENGTH OF MIDDLE TOE

The length of the middle toe was measured as the distance from the point of its junction with the outer toe to the base of the claw. The measurement proved to be of slight value as a geographically variable character. Whatever significant variation does occur, is similar to the variation in the length of metatarsus and to a considerable degree seems to be correlated with it. The measurement is difficult to make in a uniform manner owing to the different ways in which the feet have been arranged in the study skins before drying. The coefficient of variability is relatively high, being from 3 to 4 per cent. In several instances, the average for adult males is exceeded by the average of one of the other groups, as figure 5 illustrates. Most of the differences among the age and sex groups must be ascribed to random sampling coupled with high individual and fortuitous variation, resulting partly from the difficulties attending the taking of the measurement. Females appear to be slightly smaller than males, but any significant differences between the age groups cannot be inferred from the data at hand.

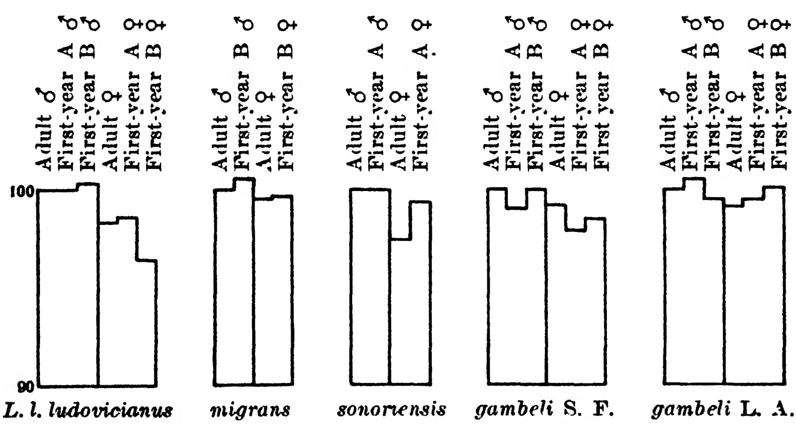

Fig. 5. Diagrams showing sexual and age variation in length of middle toe in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

LENGTH OF HIND TOE

The length of the hind toe was taken as the distance from the junction of the toe with the metatarsus, as indicated by the basal fold on the palmar surface, to the plantar base of the claw. This character is more readily measured than the preceding one. It is of limited importance as a geographic variant, however, usually paralleling the

TABLE 4

Sexual and Age Variation in Length of Middle Toe

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l. ludovicianus	♂	adult	44	12.91±0.04	.40±0.03	3.09±0.23
l. ludovicianus	♂	first-year, A.	27	12.92±0.05	.38±0.03	2.94±0.27
l. ludovicianus	♂	first-year, B.	13	12.95±0.09	.50±0.04	3.49±0.44
l. ludovicianus	♀	adult	30	12.70±0.05	.43±0.04	3.38±0.29
l. ludovicianus	♀	first-year, A.	12	12.74	....	....
l. ludovicianus	♀	first-year, B.	6	12.45	....	....
l. migrans	♂	adult	17	13.01±0.07	.45±0.05	3.45±0.39
l. migrans	♂	first-year, B.	19	13.08±0.08	.52±0.06	3.97±0.43
l. migrans	♀	adult	16	12.96±0.06	.37±0.04	2.85±0.34
l. migrans	♀	first-year, B.	17	12.98±0.08	.51±0.06	3.92±0.45
l. sonoriensis	♂	adult	37	13.42±0.06	.51±0.04	3.80±0.29
l. sonoriensis	♂	first-year, A.	33	13.41±0.06	.51±0.04	3.80±0.31
l. sonoriensis	♀	adult	28	13.06±0.08	.64±0.06	4.90±0.45
l. sonoriensis	♀	first-year, A.	13	13.33	....	....
l. gambeli, S.F.	♂	adult	21	13.34±0.07	.46±0.05	3.42±0.35
l. gambeli, S.F.	♂	first-year, A.	14	13.31±0.09	.51±0.07	3.83±0.48
l. gambeli, S.F.	♂	first-year, B.	6	13.45	....	....
l. gambeli, S.F.	♀	adult	16	13.34±0.06	.37±0.04	2.77±0.33
l. gambeli, S.F.	♀	first-year, A.	19	13.16±0.06	.36±0.04	2.73±0.29
l. gambeli, S.F.	♀	first-year, B.	9	13.24	....	....
l. gambeli, L.A.	♂	adult	24	13.31±0.04	.28±0.03	2.10±0.20
l. gambeli, L.A.	♂	first-year, A.	28	13.38±0.05	.42±0.04	3.13±0.28
l. gambeli, L.A.	♂	first-year, B.	8	13.25	....	....
l. gambeli, L.A.	♀	adult	23	13.20±0.07	.47±0.04	3.56±0.35
l. gambeli, L.A.	♀	first-year, A.	25	13.25±0.05	.39±0.04	2.94±0.28
l. gambeli, L.A.	♀	first-year, B.	11	13.33	....	....

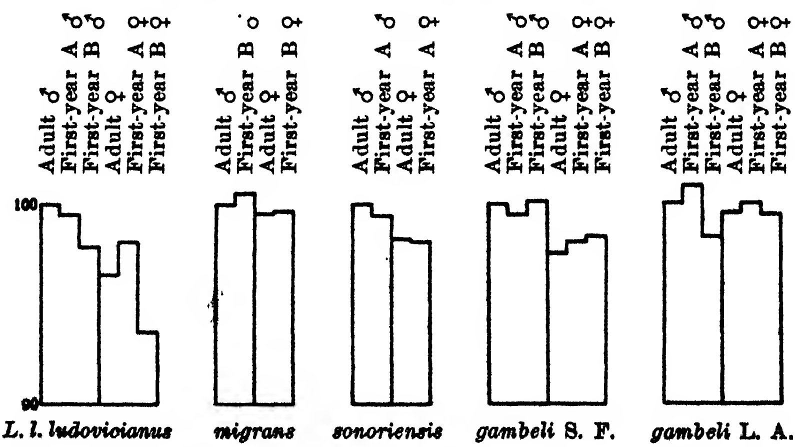

Fig. 6. Diagrams showing sexual and age variation in length of hind toe in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

variations seen in the other measurements of the foot. As with the middle toe, females tend to possess shorter hind toes than males, but the differences between age groups do not suggest any definite trend of age variation.

TABLE 5

SEXUAL AND AGE VARIATION IN LENGTH OF HIND TOE

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l ludovicianus	♂	adult	43	9 94±0 03	33±0 02	3 31±0 24
l ludovicianus	♂	first-year, A	27	9 90±0 03	22±0 02	2 22±0 20
l ludovicianus	♂	first-year, B	14	9 74±0 06	34±0 03	3 49±0 44
l ludovicianus	♀	adult	30	9 59±0 04	33±0 03	3 44±0 29
l ludovicianus	♀	first-year, A	12	9 76		
l ludovicianus	♀	first-year, B	6	9 31		
l migrans	♂	adult	18	9 73±0 05	29±0 03	2 98±0 33
l migrans	♂	first-year, B	19	9 72±0 05	30±0 03	3 08±0 33
l migrans	♀	adult	16	9 78±0 08	45±0 05	4 60±0 54
l migrans	♀	first-year, B	17	9 74±0 06	39±0 05	4 00±0 46
l sonoriensis	♂	adult	38	10 28±0 04	36±0 03	3 50±0 28
l sonoriensis	♂	first-year, A	36	10 22±0 05	41±0 03	4 01±0 31
l sonoriensis	♀	adult	28	10 10±0 04	34±0 03	3 36±0 30
l sonoriensis	♀	first-year, A	12	10 09		
l gambeli, S F	♂	adult	20	10 18±0 04	28±0 03	2 77±0 29
l gambeli, S F	♂	first-year, A	14	10 13±0 05	28±0 04	2 76±0 35
l gambeli, S F	♂	first-year, B	6	10 20		
l gambeli, S F	♀	adult	16	9 93±0 05	29±0 03	2 93±0 34
l gambeli, S F	♀	first-year, A	19	9 99±0 05	33±0 04	3 30±0 36
l gambeli, S F	♀	first-year, B	9	10 02		
l gambeli, L A	♂	adult	24	10 11±0 04	31±0 03	3 09±0 30
l gambeli, L A	♂	first-year, A	28	10 21±0 04	34±0 03	3 33±0 30
l gambeli, L A	♂	first-year, B	9	9 94		
l gambeli, L A	♀	adult	23	10 06±0 06	41±0 04	4 07±0 40
l gambeli, L A	♀	first-year, A	25	10 02±0 05	37±0 04	3 69±0 25
l gambeli, L A	♀	first-year, B	11	10 05		

LENGTH OF BILL

Following the method used by Strong (1901, p. 275), the bill length was measured by taking the distance from the anterior margin of the nostril to the tip of the upper mandible. Since the nostril is small and the nasal capsule well ossified in shrikes, this method of measuring has proved more reliable than measuring from the base of the culmen, which point is difficult of exact determination. In captive birds it was found that the bill is continuous in its growth and that periodic breakage or wearing away of the tip alone prevents excessive development. This growth, however, seems to be limited to the part of the bill distal to the tomial tooth of the upper mandible. Excessive growth of the bill usually results, then, in producing the tip in the direction of

curvature. Therefore, in beaks which are naturally strongly curved the distal hook is increased by growth without adding greatly to the total length of bill. In races such as *excubitorides, migrans,* and more especially in *ludovicianus,* growth at the tip adds almost directly to the length of bill inasmuch as the tip is less curved in these races than in others.

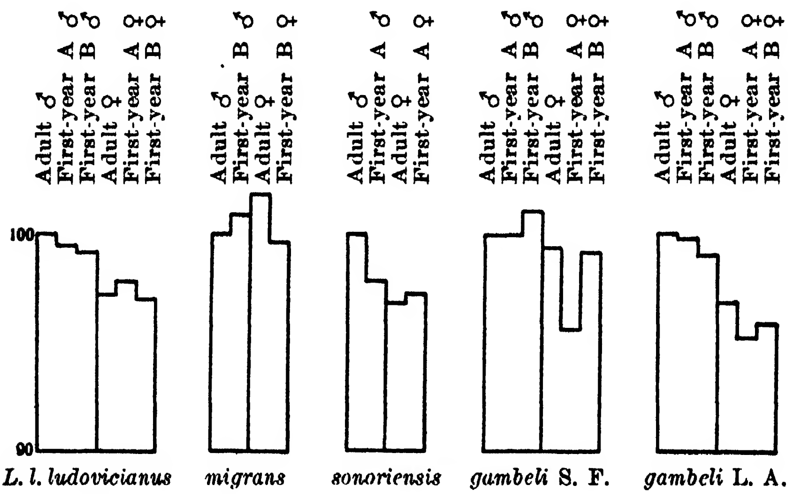

Fig. 7. Diagrams showing sexual and age variation in length of bill in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

Regardless of the possibility of excessive growth, the measurements for the various races show a degree of constancy sufficient to make the character of bill length valuable in describing subspecies. Occasional wide departures from the mean of a geographic race, however, must not be construed as a mixture of races unless other characters bear out the differences seen in bill length. Males tend to develop longer bills than females and within the sex groups the bills usually increase in length with age. These age differences are so slight, however, as occasionally to be obscured by random sampling. A peculiar reversal of the usual relative position of male and female is seen in *migrans;* in this race the data again seem to indicate a lack of sexual differentiation.

TABLE 6

SEXUAL AGE VARIATION IN LENGTH OF BILL

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l ludovicianus	♂	adult	43	12 36±0 05	51±0 04	4 12±0 29
l ludovicianus	♂	first-year, A	27	12 31±0 05	39±0 04	3 16±0 29
l ludovicianus	♂	first-year, B	14	12 26±0 05	52±0 07	4 24±0 54
l ludovicianus	♀	adult	30	12 02±0 04	33±0 03	2 74±0 24
l ludovicianus	♀	first-year, A	10	12 09		
l ludovicianus	♀	first-year, B	6	12 00		
l migrans	♂	adult	18	11 38±0 09	57±0 06	5 00±0 56
l migrans	♂	first-year, B	19	11 49±0 09	57±0 06	4 96±0 54
l migrans	♀	adult	16	11 60±0 09	57±0 07	4 74±0 56
l migrans	♀	first-year, B	16	11 35±0 10	61±0 07	5 37±0 64
l sonoriensis	♂	adult	39	12 31±0 04	41±0 03	3 33±0 25
l sonoriensis	♂	first-year, A	36	12 06±0 07	58±0 05	4 80±0 38
l sonoriensis	♀	adult	29	11 93±0 04	34±0 03	2 84±0 25
l sonoriensis	♀	first-year, A	12	11 97		
l gambeli, S F	♂	adult	20	11 71±0 07	47±0 05	4 01±0 42
l gambeli, S F	♂	first-year, A	14	11 70±0 09	52±0 07	4 44±0 56
l gambeli, S F	♂	first-year, B	5	11 84		
l gambeli, S F	♀	adult	15	11 65±0 09	54±0 07	4 63±0 57
l gambeli, S F	♀	first-year, A	19	11 21±0 09	58±0 06	5 17±0 56
l gambeli, S F	♀	first-year, B	9	11 61		
l gambeli, L A	♂	adult	24	11 94±0 08	60±0 06	5 02±0 48
l gambeli, L A	♂	first-year, A	27	11 92±0 08	64±0 06	5 36±0 50
l gambeli, L A	♂	first-year, B	9	11 83		
l gambeli, L A	♀	adult	23	11 58±0 08	54±0 05	4 66±0 46
l gambeli, L A	♀	first-year, A	25	11 37±0 06	43±0 04	3 78±0 36
l gambeli, L A	♀	first-year, B	11	11 45		

DEPTH OF BILL

The measurement was taken in the transectional plane of the nostrils at their middle; it is the greatest depth with the mandibles closed in normal position. When all specimens with abnormally placed lower mandibles were excluded, this measurement proved to be more reliable than that of length of bill since the condition of variability at the tip of the bill was not involved. Owing, no doubt, to a smaller amount of individual variability in this character of depth, the diagrams representing age and sex groups show a more orderly plan of variation than do the diagrams for bill length. Thus, it is clearly shown that females average smaller than males, and with a few exceptions the averages show an increase with age. This measurement has been used successfully in characterizing some of the geographic races.

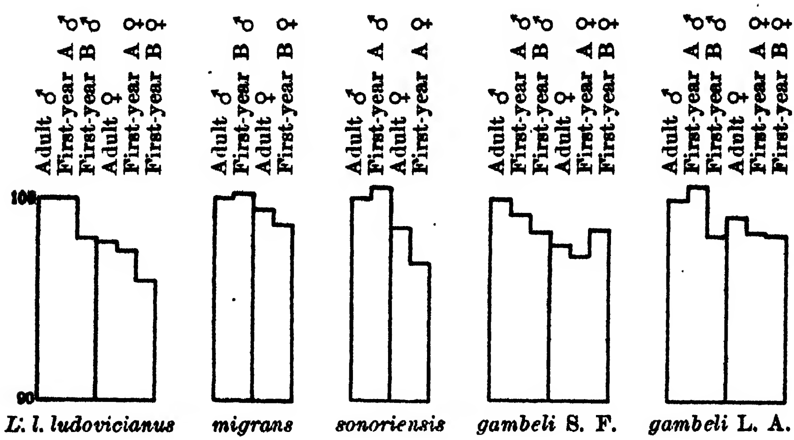

Fig. 8. Diagrams showing sexual and age variation in depth of bill in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

TABLE 7

SEXUAL AND AGE VARIATION IN DEPTH OF BILL

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l. ludovicianus	♂	adult	34	8 83±0 02	.21±0 02	2.37±0 19
l. ludovicianus	♂	first-year, A.	20	8.83±0 04	.25±0.03	2.83±0 30
l. ludovicianus	♂	first-year, B.	9	8.86	....	....
l. ludovicianus	♀	adult	26	8 65±0 03	.25±0 02	2 89±0 27
l. ludovicianus	♀	first-year, A.	8	8.60	....	....
l. ludovicianus	♀	first-year, B.	4	8 47	....	....
l. migrans	♂	adult	17	8.24±0.04	.23±0 03	2 79±0.32
l. migrans	♂	first-year, B.	16	8 26±0 04	.31±0 04	3.75±0 44
l. migrans	♀	adult	9	8.20	....	....
l. migrans	♀	first-year, B.	14	8.14±0.04	.23±0.03	2.82±0 35
l. sonoriensis	♂	adult	29	8.45±0.03	.23±0 02	2.72±0.22
l. sonoriensis	♂	first-year, A.	32	8.50±0.02	.20±0.02	2.35±0.19
l. sonoriensis	♀	adult	24	8.34±0.03	.19±0.02	2.27±0.22
l. sonoriensis	♀	first-year, A.	9	8.18	....	....
l. gambeli, S.F.	♂	adult	17	8 31±0 03	.21±0.03	2.52±0.29
l. gambeli, S.F.	♂	first-year, A.	14	8.25±0.04	.23±0 03	2.78±0.35
l. gambeli, S.F.	♂	first-year, B.	6	8.18	....	....
l. gambeli, S.F.	♀	adult	13	8.13±0.05	.27±0.04	3.32±0.43
l. gambeli, S.F.	♀	first-year, A.	19	8.08±0.04	.27±0.03	3.34±0.36
l. gambeli, S.F.	♀	first-year, B.	9	8.20	....	....
l. gambeli, L.A.	♂	adult	24	8.37±0.03	.20±0.02	2.38±0.23
l. gambeli, L.A.	♂	first-year, A.	23	8.43±0.03	.19±0.02	2.25±0.22
l. gambeli, L.A.	♂	first-year, B.	7	8.22	....	....
l. gambeli, L.A.	♀	adult	18	8.30±0.02	.15±0.02	1.80±0.20
l. gambeli, L.A.	♀	first-year, A.	22	8.24±0.03	.22±0.02	1.66±0.17
l. gambeli, L.A.	♀	first-year, B.	11	8.23	....	....

Width of Bill

The width of the bill was measured at the nostril; but, owing to the converging lateral surfaces of the bill, it was found difficult to avoid a personal error in measuring. The coefficient of variability

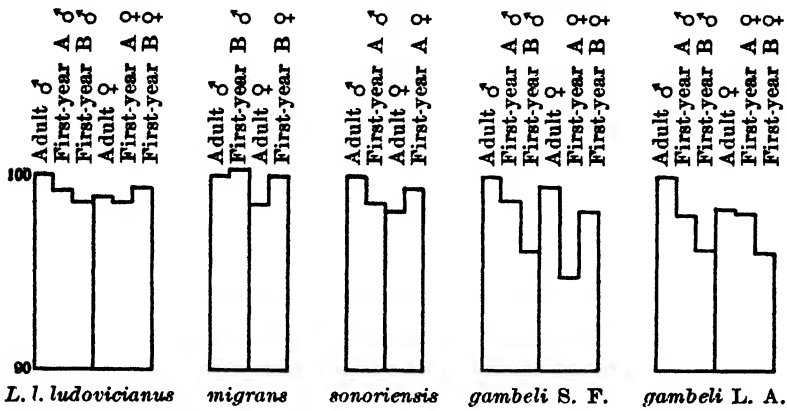

Fig. 9. Diagrams showing sexual and age variation in width of bill in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

TABLE 8

Sexual and Age Variation in Width of Bill

Measurements in millimeters

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent)
l. ludovicianus	♂	adult	43	6 39±0 03	.26±0.02	4 06±0.39
l. ludovicianus	♂	first-year, A.	27	6 34±0 04	.31±0.03	4 88±0.44
l. ludovicianus	♂	first-year, B.	13	6 31±0.08	.45±0 06	7 31±0 94
l. ludovicianus	♀	adult	31	6 32±0.03	26±0.02	4.14±0 35
l. ludovicianus	♀	first-year, A.	10	6 31		
l. ludovicianus	♀	first-year, B.	6	6 35		
l. migrans	♂	adult	18	6 02±0.04	.28±0.03	4.65±0.52
l. migrans	♂	first-year, B.	18	6 04±0 04	.23±0 03	3.80±0.42
l. migrans	♀	adult	15	5.95±0.04	.24±0 03	4 03±0.49
l. migrans	♀	first-year, B.	16	6 02±0.05	.33±0 04	5.48±0.65
l. sonoriensis	♂	adult	29	6.21±0.03	.28±0 02	4 50±0.34
l. sonoriensis	♂	first-year, A.	36	6 13±0.03	.27±0.02	4.40±0.34
l. sonoriensis	♀	adult	27	6.10±0.03	.23±0.02	3.77±0.34
l. sonoriensis	♀	first-year, A.	11	6.17		
l. gambeli, S.F.	♂	adult	20	6.19±0.05	.30±0 03	4.84±0.51
l. gambeli, S.F.	♂	first-year, A.	14	6 12±0.04	.22±0.03	3.59±0.45
l. gambeli, S.F.	♂	first-year, B.	5	5.96		
l. gambeli, S.F.	♀	adult	15	6.17±0.05	.31±0.04	5.02±0.61
l. gambeli, S.F.	♀	first-year, A.	19	5.88±0.03	.21±0.02	3.57±0.39
l. gambeli, S.F.	♀	first-year, B.	9	6.08		
l. gambeli, L.A.	♂	adult	25	6.17±0.03	.25±0.02	4.05±0.38
l. gambeli, L.A.	♂	first-year, A.	27	6.05±0.04	.31±0 03	5.12±0.47
l. gambeli, L.A.	♂	first-year, B.	9	5.94		
l. gambeli, L.A.	♀	adult	23	6.07±0.03	.23±0.02	3.78±0.37
l. gambeli, L.A.	♀	first-year, A.	25	6.01±0.03	.21±0.02	3.49±0.33
l. gambeli, L.A.	♀	first-year, B.	11	5.93		

is not excessively high, however, and the measurement has been found useful in diagramming the proportions of the bills of the various subspecies. As with the foregoing measurements, females and first-year individuals possess slightly narrower bills than do males and adults.

EXTENT OF BASAL WHITE AREA OF PRIMARIES

In an effort to determine the amount of white on the primaries irrespective of variation in primary length, a measurement was taken from the distal edge of the basal white area to the wrist and this figure for each individual translated into percentage of the total wing length (length of primaries from wrist to tip). Since the white on the primaries extends to their bases, this percentage should be a fairly accurate index of the degree of white present.

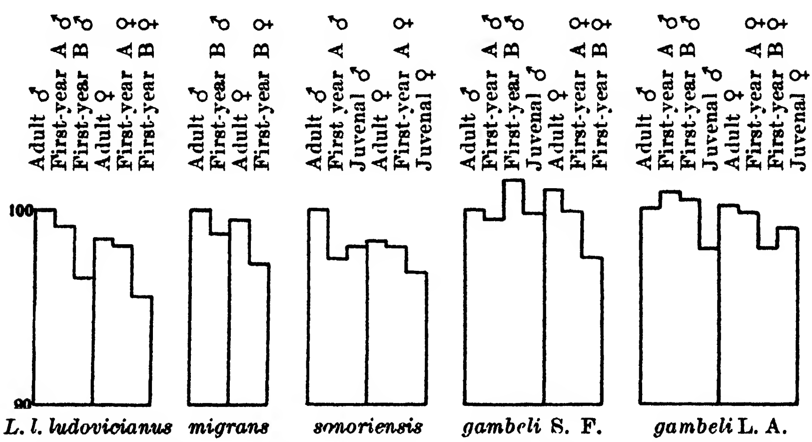

Fig. 10. Diagrams showing sexual and age variation in amount of white on primaries in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see table 1.

The amount of white on the primaries has been found to be of considerable use in differentiating subspecies, ranking in degree of importance with the measurements of the wing and tail. In *L. l. ludovicianus*, *migrans*, and *sonoriensis* pronounced sexual and age variation is to be noted, males and adults possessing the larger white patches. In *gambeli*, however, there is practically no consistent sexual or age difference discernible in the diagrams and table. This difference between *gambeli* and the other races with which comparisons are possible is sufficient to suggest that *gambeli* represents a primitive, or at least a more stable condition wherein there is little change with age or development of the gonads.

TABLE 9

SEXUAL AND AGE VARIATION IN AMOUNT OF WHITE ON PRIMARIES

Figures represent per cent of total primary length

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variability (per cent of mean)
l ludovicianus	♂	adult	44	54 58±0 17	1 75±0 13	3 20±0 24
l ludovicianus	♂	first-year, A	26	54 12±0 14	1 12±0 10	2 60±0 19
l ludovicianus	♂	first-year, B	14	52 71±0 30	1 67±0 21	3 16±0 40
l ludovicianus	♀	adult	31	53 86±0 19	1 57±0 13	2 04±0 17
l ludovicianus	♀	first-year, A	11	53 60		
l ludovicianus	♀	first-year, B	6	52 21		
l migrans	♂	adult	18	54 93±0 27	1 73±0 19	3 14±0 35
l migrans	♂	first-year, B	19	54 31±0 21	1 36±0 14	2 50±0 27
l migrans	♀	adult	15	54 61±0 23	1 33±0 16	2 43±0 29
l migrans	♀	first-year, B	16	53 44±0 18	1 08±0 12	2 03±0 24
l sonoriensis	♂	adult	37	57 56±0 16	1 51±0 11	2 62±0 20
l sonoriensis	♂	first-year, A	35	56 14±0 18	1 61±0 12	2 87±0 23
l sonoriensis	♂	juvenal	10	56 49		
l sonoriensis	♀	adult	26	56 65±0 28	2 13±0 19	3 75±0 35
l sonoriensis	♀	first-year, A	13	56 49		
l sonoriensis	♀	juvenal	10	55 72		
l gambeli, S F	♂	adult	20	55 37±0 20	1 38±0 14	2 49±0 26
l gambeli, S F	♂	first-year, A	13	55 16±0 30	1 65±0 28	2 99±0 39
l gambeli, S F	♂	first-year, B	6	56 25		
l gambeli, S F	♂	juvenal	9	55 26		
l gambeli, S F	♀	adult	14	55 93±0 25	1 43±0 18	2 55±0 32
l gambeli, S F	♀	first-year, A	18	55 33±0 18	1 18±0 13	2 13±0 23
l gambeli, S F	♀	first-year, B	9	54 07		
l gambeli, L A	♂	adult	24	55 73±0 21	1 56±0 16	2 79±0 27
l gambeli, L A	♂	first-year, A	21	56 24±0 22	1 52±0 15	2 70±0 28
l gambeli, L A	♂	first-year, B	9	56 02		
l gambeli, L A	♂	juvenal	16	54 62±0 31	1 86±0 22	3 40±0 40
l gambeli, L A	♀	adult	22	55 80±0 18	1 28±0 13	2 29±0 23
l gambeli, L A	♀	first-year, A	17	55 62±0 19	1 18±0 13	2 12±0 24
l gambeli, L A	♀	first-year, B	11	54 66		
l gambeli, L A	♀	juvenal	11	55 18		

The individual variability is sufficiently small so that in distinguishing races which show marked differences in this character, individual specimens frequently may be identified by inspection of the primary patch. Among other races where the contrasts in this character are less pronounced a comparison of averages is the only method of identification which properly may be employed.

WHITE ON OUTER RECTRICES

Ridgway (1904, pp. 235, 236), Oberholser (1918, p. 209), and others have made considerable use of the geographic variation in the amount of white on the rectrices to characterize many of the subspecies of *L. ludovicianus*. When this character is analyzed it is found to show greater individual variation than any other of the ten dimensions here treated in a similar way. The coefficient of varia-

bility is usually between 10 and 20 per cent of the mean. Were it not for a correspondingly great range of geographic variation the character would be of no taxonomic value.

In order to measure the amount of white on the rectrices, the greatest extent of the white spot on the inner web of the distal end of the outer rectrix was taken, the left rectrix being used unless it was lacking or mutilated, in which case the right rectrix was substituted. This figure, then, was reduced to per cent of the total length of tail.

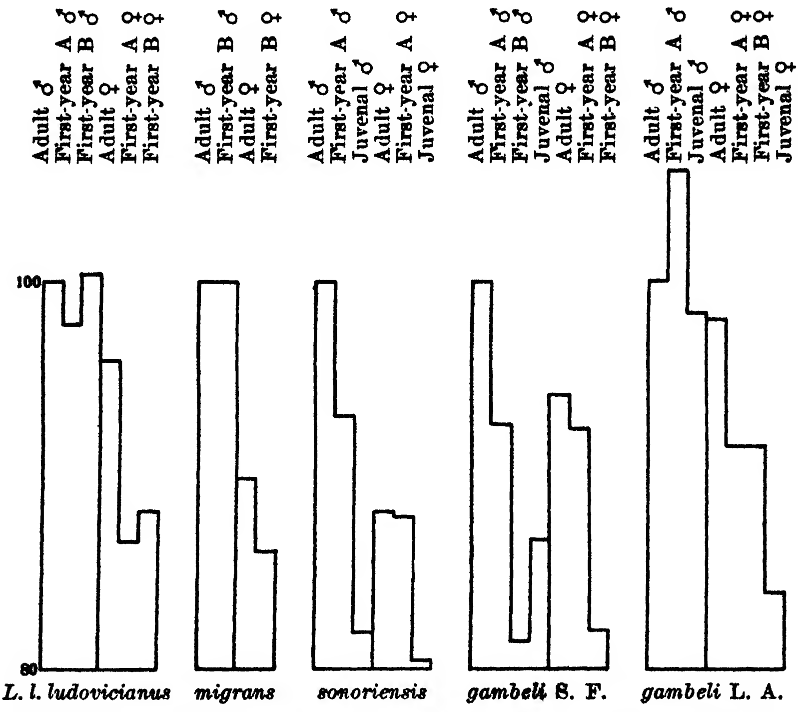

Fig. 11. Diagrams showing sexual and age variation in amount of white on outermost rectrix in five geographic groups. Height of columns indicates per cent, adult males in each group being taken as 100 per cent. For definitions of age and geographic groups see tables 1 and 10.

It would have been more desirable to calculate the per cent of white by using the total length of the outer rectrix rather than the total length of tail, but the difficulties attending the measurement of the length of the outer rectrix are such as to make impracticable this latter mode of procedure. The graduation of the tail has been found to vary but little, and thus, the relation between the total length of tail and the length of the outer rectrix may be considered as being fairly constant. In races where there are extensive white areas on the tail, it frequently happens that the basal white spot and the distal

which spot on the outer rectrix merge completely. This happens in about 50 per cent of the members of the race *excubitorides.* Manifestly it would be incorrect to add the basal white spot to the distal tipping in such cases where the two white areas are not separated by a complete black zone. It was found that the point where the two areas

TABLE 10

SEXUAL AND AGE VARIATION IN AMOUNT OF WHITE ON OUTERMOST RECTRIX

Figures represent per cent of total tail length

Geographic group	Sex	Age group	Number of specimens	Mean	Standard deviation	Coefficient of variation (per cent of mean)
l ludovicianus	♂	adult	43	39 27±0 36	3 54±0 25	9 01±0 65
l ludovicianus	♂	first-year, A	24	38 44±0 59	4 31±0 42	11 21±1 09
l ludovicianus	♂	first-year, B	9	39 46		
l ludovicianus	♀	adult	30	37 69±0 52	4 16±0 36	11 03±0 96
l ludovicianus	♀	first-year, A	10	34 04		
l ludovicianus	♀	first-year, B	4	34 60		
l migrans	♂	adult	17	42 03±0 77	4 71±0 54	11 20±1 29
l migrans	♂	first-year, B	15	42 03±0 56	3 16±0 38	7 51±0 92
l migrans	♀	adult	15	37 77±1 00	5 76±0 71	15 25±1 88
l migrans	♀	first-year, B	11	36 29±0 49	2 44±0 35	6 72±0 96
l sonoriensis	♂	adult	32	34 55±0 66	5 54±0 46	16 04±1 35
l sonoriensis	♂	first-year, A	34	32 19±0 69	5 94±0 48	18 45±1 51
l sonoriensis	♂	juvenal	8	28 31		
l sonoriensis	♀	adult	26	30 47±0 56	4 29±0 39	13 94±1 31
l sonoriensis	♀	first-year, A	12	30 40		
l sonoriensis	♀	juvenal	9	27 81		
l gambeli, S F	♂	adult	19	33 90±0 81	5 23±0 57	15 42±1 68
l gambeli, S F	♂	first-year, A	14	31 45±0 72	4 00±0 53	12 71±1 62
l gambeli, S F	♂	first-year, B	4	26 70		
l gambeli, S F	♂	juvenal	9	29 42		
l gambeli, S F	♀	adult	14	31 90±0 84	4 67±0 59	14 63±1 87
l gambeli, S F.	♀	first-year, A	18	31 35±1 08	6 80±0 79	21 69±2 46
l gambeli, S F	♀	first-year, B	6	27 81		
l gambeli, L A	♂	adult	22	30 52±0 83	5 80±0 59	19 00±1 93
l gambeli, L A	♂	first-year, A	20	32 28±0 96	6 30±0 67	19 51±2 08
l gambeli, L A	♂	juvenal	11	30 02		
l gambeli, L A	♀	adult	19	29 94±1 08	6 98±0 76	23 30±2 55
l gambeli, L A	♀	first-year, A	16	27 93±0 82	4 87±0 58	17 43±2 09
l gambeli, L A	♀	first-year, B	4	27 92		
l gambeli, L A	♀	juvenal	11	25 63		

First-year, A = first-year birds in which the outer primaries and all the rectrices have been replaced during the first fall molt, first-year, B = first-year birds in which all the primaries are juvenal but in which at least the center and outer rectrices have been replaced during the first fall molt.

joined was usually about 45.0 mm. from the tip of the feather in *L. ludovicianus* and 55.0 mm. in *L. excubitor.* Consequently, these figures were used to represent the white tipping wherever feathers occurred that were entirely white or where the two white areas were confluent. Admittedly there are objections to treating the problem in this way, but I have been unable to devise a more accurate, practicable means of comparing the amount of white on the tips of the rectrices.

There is a marked sex difference in the amount of white on the tail, the difference in some cases being as much as 12 per cent of the mean of adult males; yet in view of the wide range of individual variation this cannot serve to distinguish the sexes with certainty. Age variation is somewhat less clearly shown but does occur regardless of certain irregularities seen in figure 11, which certainly seem to be due to random sampling.

Weight

To make any complete analysis of weight has not been possible, much as such treatment might be desired. It has been impossible for me to obtain the weights of a sufficient number of shrikes to make significant averages except in the case of *gambeli*. However, a small number of weights are available for *nevadensis*, *sonoriensis*, *grinnelli*, and *nelsoni*. Evidently there are racial differences in weight as is apparent in comparing *nelsoni* with *gambeli* (see table 14). The species *L. excubitor* is approximately 30 per cent heavier than *L. ludovicianus*.

The difference between the sexes is slight, probably amounting to less than 1 per cent of the mean of adult males, the females being the smaller. Nevertheless, females taken during the early breeding season weigh more than males. Except for breeding females, first-year birds average from 3 to 5 per cent lighter than the adults. The range of weight that any one individual may undergo is large as evinced by the observation made of a cage bird which varied as much as ten grams, or one-fifth of its weight, in the course of a week. This variation was due to moderate starvation alternated with abundant feeding. A graph showing the juvenal increase in weight is included under the section dealing with the development of the young.

SHAPES AND PROPORTIONS

Wing and Tail

In most of the American shrikes the wing is shorter than the tail, *migrans*, *borealis*, and *invictus* being the exceptions. The ratio of wing to tail was not calculated for each bird separately but was computed on the basis of averages solely. Relative to the wing, the tail is shorter in females than in males. Likewise, the tail is relatively shorter in juveniles than in first-year birds, and the latter, in turn, shorter than in adults. Figure 12 shows a comparison of the

age and sex groups, the ratio of the adult males being taken as the standard and considered to be 100 per cent. Increase of the length of the column in the diagram indicates an approach toward a 1 to 1 ratio except in the case of *migrans*, in which the ratio in the adult males is practically 1 to 1 and that in the females slightly greater, that is, in the direction of 2 to 1.

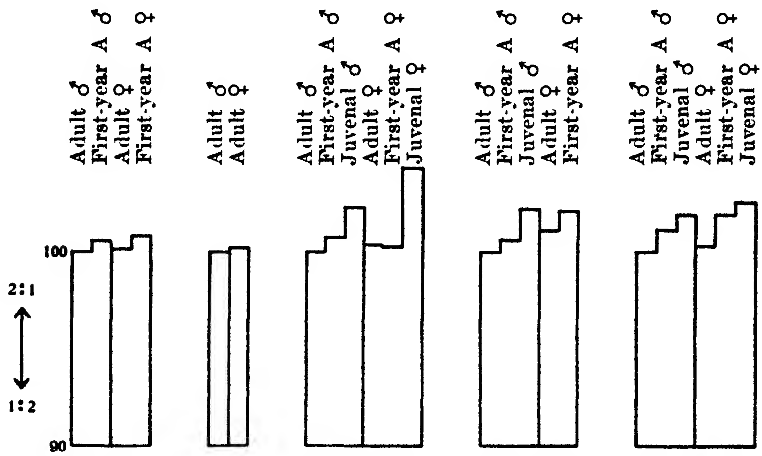

Fig. 12. Diagrams showing sexual and age variation in ratio of wing to tail in five geographic groups. In each geographic group the ratio in adult males is taken as 100 per cent. Difference in length of columns indicates change in ratio relative to that of the adult males in the direction indicated by the arrows at the left of the diagram. First-year *A* = first-year birds in which both outer primaries and the rectrices have been replaced during first fall molt. For definitions of geographic groups see table 1.

Taxonomic use of the wing-tail ratio can be made in several of the races of *L. ludovicianus*. William Palmer (1898, p. 248), Ridgway (1904, p. 243), and others have already employed it in distinguishing the subspecies *ludovicianus* and *migrans*.

Wing Formula

The sixth, seventh, and eighth primaries constitute the tip of the wing, all three being of nearly the same length. Of these three feathers either the seventh or the eighth, if they are not precisely equal, is the longest. In *borealis* and *invictus* the seventh is invariably the longest, but in the species *ludovicianus* there is little constancy as to which of the two feather lengths is the greater. Both types of wing tip may be found in any of the races of *L. ludovicianus* although there is a larger per cent of birds in the races of southern distribution in which the seventh primary is longest; especially is this the case in

the subspecies *L. l. ludovicianus*. The character is of insufficient stability to warrant making a numerical comparison of the type of wing tip occurring in the various subspecies.

Of equally slight importance is the relation of the ninth and fifth primaries. Again, in *borealis* and *invictus* the ninth is always shorter than the fifth and this is the usual condition in *L. l. ludovicianus*. But in the other races of the Loggerhead Shrike there is no constant relation between these two feathers.

As might be predicted, then, the more southern forms of the Loggerhead Shrike which do not migrate tend to have more rounded wing tips than races such as *migrans* and *excubitorides*. The North American members of *L. excubitor*, although distinctly migratory, possess comparatively rounded wing tips, which is indicative of a slight, though distinct, specific difference in contrast with *L. ludovicianus*. If a race of *L. ludovicianus* occurred in the region occupied by *borealis*, one certainly should expect to find it possessed of the best developed outer primaries of any member of the American group.

Graduation of Tail

It was hoped that an investigation of the difference in length between inner and outer rectrices would disclose an interesting variable. The differences to be noted in measurements taken of the distance between the tips of these two feathers, however, are those differences due to the total variation in the size of the tail. Thus, tails which are long measure proportionately long between the tips of the outer and inner rectrices, and vice versa. The only exception to this lack of variability is found in *L. excubitor* which in contrast with the Loggerhead Shrikes shows less graduation of the tail in proportion to the total tail length.

Tarsometatarsus

Skeletons have not been available to use in comparing the metatarsi of the various subspecies. Within the species, so far as can be learned, there is no variation in width out of proportion to the general variation in size as indicated by a measurement of total length taken from study skins. *Borealis* and *invictus* possess a relatively shorter and slightly stockier metatarsus than the metatarsus of the Loggerhead Shrikes. The total length of the metatarsus in *borealis* averages about 26.3 mm. in males, which is less than the length in any of the smaller races of *L. ludovicianus*.

Segmentation of Planta Tarsium

The American *l. excubitor* frequently, but not always, shows a segmentation of the exterior section of the planta tarsium. In *L. ludovicianus* the planta tarsium is unsegmented. The character in *L. excubitor* is subject to wide individual variation.

Relative Length of Toes

No important variation in the relative lengths of the toes has been detected, except in *grinnelli* in which the hind toe appears to average relatively short.

Proportions of Bill

Useful differences in the relative thickness and length of the bill have been discovered. These differences are shown by means of a series of ideograms (figs. 33–35) designed to emphasize the varying proportions computed from the series of average measurements of width, depth, and length of bill. Geographic variation alone has been treated although doubtless there are minor sex and age variations existent.

Curvature of Culmen

Strong (1901, p. 275) endeavored to measure the curvature of the culmen by photographing the bill and then, from the photographic outline, computing the angle of curvature at a fixed point near the tip. Of course, the curvature varies at different points along the culmen, but it was believed by Strong that the curvature at any one point was a fairly accurate index of the curvature of the entire culmen. To my mind the varying curvature of the bill cannot be treated suitably by the statistical method. A wide range of variability in shape of the culmen results from the differing conditions of the growing tip. Nevertheless, certain characteristic features of shape can be ascribed to some of the races of *Lanius ludovicianus*.

One might include under a discussion of characters, features of a physiological nature such as molt, migration, or other variables pertaining to the natural history of the animals. It is believed in the case of molt that there are genetic differences in addition to immediate environmental causes which produce the variation in molt to be observed among the several subspecies. Nevertheless, the formal description of species and subspecies will be limited to structural char-

acters. Later an attempt will be made to correlate certain variations concerning natural history with the taxonomic units as defined on the basis of structure.

Characterization of Species and Subspecies

In the following descriptions no attempt is made to catalogue all references in the literature to each of the forms treated, but an effort has been made to list the sources of all synonyms known to have been applied to the American shrikes here considered. The merits involved in separating from the genus *Lanius* such proposed generic groups as *Otomela, Phoneus, Fiscus,* etc., do not fall within the scope of this paper. The characterization of the genus *Lanius* which follows is designed with particular reference to the American members of the family. All dimensions included under descriptions are average measurements.

Genus **Lanius** Linnaeus

Lanius Linnaeus (1758, p. 93), original description.
Collurio Brisson (1760, p. 151).
Collyrio Moehring (1752, p. 28).

Type.—*Lanius excubitor* Linnaeus, by subsequent designation, Swainson (1824).

Description.—Bill strong, compressed, upper mandible moderately or strongly hooked, the hook preceded by a tomial notch and tooth; lower mandible with upturned acute tip which fits into tomial notch and longitudinal groove beneath hook of upper mandible, shearing against distal face of tomial tooth; nostril small, rounded, partly concealed by bristle-tipped, anteriorly directed feathers at base of bill. Acrotarsium divided into seven or eight scutes each complete across dorsal surface of tarsometatarsus; outer segment of planta tarsium either consolidated or divided into scutes; middle toe with claw about half as long as tarsometatarsus; lateral toes of approximately equal length reaching slightly beyond base of middle claw; hallux stout and shorter than lateral toes; basal phalanx of middle toe attached to outer toe for at least half its length; claws sharp and strongly curved. Wing short, rounded, with ten well developed primaries, one vestigial (eleventh) primary, and nine secondaries; sixth to eighth primaries longest. Tail either longer or shorter than wing, composed of twelve rectrices, moderately graduated. Body plumage soft, loose vaned; head densely feathered but not crested.

Coloration: chiefly grays, white, and black, with brown and rufous more frequently present in females and immatures than in males and adults. Upper parts gray or brown; under parts whitish or light gray often tinged with browns and vermiculated with dusky drab or various

tones of gray; facial mask, wings, and tail black or brown; primaries with basal white area and outer rectrices, secondaries, and inner primaries tipped with white or buff.

Range.—Entire Holarctic region and parts of Central America and of the Ethiopian and Oriental regions.

Lanius excubitor borealis Vieillot

Lanius excubitor, Forster (1771, p. 9).
Lanius borealis Vieillot (1807 [1808], p. 80), original description.
Lanius septentrionalis, Shaw (1809, p. 331).
Collyrio borealis, Baird (1858, p. 324).
Collurio borealis, Baird (1866, p. 440).
Collyrio chemungensis Gregg (1870, p. 9 of reprint).
Lanius borealis americanus Bogdanow (1881, p. 102), part.
L(anius). excubitor, forma *borealis,* Collett (1886, p. 40), part.
Lanius excubitor borealis, Schiebel (1906, p. 61), part.

Type.—No type specimen or locality was designated by Vieillot. The specimen in his collection which was used for the description evidently was a first-year bird, since mention is made of the rusty color of the dorsal wing coverts and the under parts. The species was ascribed to all of North America and the adjacent parts of Siberia but particular mention was made of "centre des États-Unis," Canada, and the Hudson Bay region; one of these localities probably was the source of his specimen.

Description.—Males, adult, breeding plumage. Upper parts: anterior and lateral margins of forehead pale gull gray; superciliary line white; remainder of pileum, hind neck, back, and upper rump between pale and light neutral gray; tips of scapulars white; lower rump and upper tail coverts either pale or pallid neutral gray; lateral portions of frontal tufts of bristle-tipped feathers black, the two sides separated by a median white area at base of culmen; spot in front of eye black fading to gray anteriorly on lores, thus separating black area at base of bill from black orbital region; auricular, postocular, and subocular regions black except for small white spot at base of lower eyelid which may or may not be present.

Under parts: chin, throat, and malar region dull white, pure white along margin of black auricular area; breast, sides, flanks, and frequently anterior part of belly pale smoke gray, vermiculated with distinct, narrow bands of dusky drab; coverts of tibiotarsus pale neutral gray; posterior part of belly and under tail coverts dull white.

Wings: primaries dull black, numbers 1 to 4 tipped with dull white; bases of primaries, except tenth, white on both webs; seventh primary longer than eighth, fifth longer than ninth; secondaries dull black (except for inner members of series which are pure black), gray basally on margin of inner web, and tipped with white, most extensively on numbers 7 and 8; greater primary and middle secondary coverts black, tipped with minute spot of white; alula dull black margined with gray; marginal upper coverts of wrist and ulna chiefly gray or else black with gray tips; marginal coverts of hand white;

axillaries white; under wing coverts usually dark neutral gray; wing length, 113.2 mm.; basal white patch on primaries, 53.9 per cent of wing length.

Tail: rectrices moderately graduated, all tipped with white, increasing in amount from center laterally; white most extensive on outer web in numbers 4, 5, and 6 (outermost); outer web of outer rectrix entirely white; concealed bases of rectrices white except for center pair which occasionally lacks white; tail length, 113.23 mm.; white tip on inner web of outermost rectrix, 32.7 per cent of tail length; ratio of wing to tail, 1.005:1.

Bill: large; upper mandible strongly curved at tip, entirely black in dried skins; length, 13.83 mm.; depth, 8.66 mm.; width, 6.50 mm.

Feet: planta tarsium frequently segmented on outer surface; tarsometatarsus and dorsal surface of toes black in dried skins; tarsometatarsus relatively short and thick, length. 25.9 mm.; toes relatively short, middle toe, 12.03 mm.; hind toe, 9.23 mm.

Iris: brown.

Males, adult, fall plumage.—Same as breeding plumage, except bill various shades of brown distally, pale flesh color at base of mandibles.

Females, adult, breeding plumage.—Similar to males in breeding plumage but averaging slightly darker gray on head and back, near light neutral gray or light mouse gray; gray of facial mask usually slightly more pronounced. Under parts averaging slightly more buffy. Wings shorter and white of primaries less extensive; wing length, 112.48 mm.; white on primaries, 54.8 per cent of wing length. Tail shorter and white less extensive; length, 111.35 mm.; white on outer rectrix 30.8 per cent of tail length; ratio of wing to tail, 1.010:1. Bill relatively shorter; length, 13.38 mm.; depth, 8.73 mm.; width, 6.51 mm. Tarsometatarsus and toes similar to males; tarsometatarsal length, 26.15 mm.; middle toe, 12.20 mm.; hind toe, 9.33 mm.

Females, adult, fall plumage.—Same as females in breeding plumage except bill brown and pale flesh color as in adult fall males. Feathers of back occasionally lightly tipped with mouse gray and breast frequently tinged vinaceous buff, these colors to a large extent fading or wearing away during the winter.

Males, first-year, breeding plumage.—Usually similar to adult plumages of females but displaying wider range of variation depending on degree of wearing, fading, and molting of the preceding juvenal and first fall plumages. Upper parts: white and gray of forehead and superciliary line less pronounced, often tinged with vinaceous buff; head and back ranging from light neutral gray to light mouse gray or drab; rump occasionally vinaceous buff and occasionally retaining juvenal feathers; facial mask as in adult females, or preocular region chiefly gray and auricular region brown. Under parts: similar to adult females. Wings: primaries, alula, and greater primary coverts retained from juvenal plumage; secondaries usually juvenal but occasionally inner members of series renewed at fall molt; secondary coverts juvenal or partly or wholly replaced by black feathers grown during fall molt, these latter feathers tipped with either gray or drab; middle coverts black as in adults; marginal coverts of wrist mixed gray, drab, and black; under wing coverts and

margin of hand as in adults; wing length, 112.49 mm.; white on primaries, 52.9 per cent of wing length. Tail: rectrices juvenal, shorter than in adults; length 110.6 mm.; white on outer rectrix, 32.6 per cent of tail length; ratio of wing to tail, 1.017:1. Bill: similar to male adults in breeding plumage; length, 13.90 mm.; depth, 8.78 mm.; width, 6.47 mm. Feet: similar to male adults; tarsometatarsal length, 26.40 mm.; middle toe, 12.03 mm.; hind toe, 9.39 mm.

Males, first-year, fall plumage.—Extremely variable; similar to breeding first-year males, but usually drab, wood brown, or buffy brown above and ocular stripe usually brown and gray. Vermiculations more pronounced on under parts and usually present on throat. Bill color similar to male adults in fall.

Females, first-year, breeding plumage.—Similar to male first-year breeding plumage but averaging darker throughout. Under parts more frequently tinged with vinaceous buff. Wings: smaller; length, 111.06 mm.; white area on primaries frequently less sharply defined, 51.0 per cent of wing length. Tail: shorter; length, 108.76 mm.; white on outer rectrix less extensive, 25.5 per cent of tail length; ratio of wing to tail, 1.021:1. Bill: shorter, length, 13.56 mm.; depth, 8.50 mm.; width, 6.37 mm. Feet: tarsometatarsal length, 25.90 mm.; middle toe, 11.92 mm.; hind toe, 9.25 mm.

Females, first-year, fall plumage.—Similar to first fall males but averaging darker above and below; facial mask rarely black. Measurements same as first-year breeding females.

Juveniles.—Upper parts: pileum, hind neck, and rump light drab; back and scapulars drab or wood brown; upper tail coverts drab basally, extensively tipped with wood brown; pileum, scapulars, lower rump, and upper tail coverts finely vermiculated, each feather with two narrow dusky bars; frontal tufts vinaceous buffy; rictal bristles black; lores, preocular region, and spot on lower eyelid varying shades of gray; auricular region hair brown.

Under parts: chin white changing on throat, breast, sides, and flanks to drab gray with fine dusky vermiculations two to each feather; belly and under tail coverts white, the latter barred with two dusky bands.

Wings: primaries dull black with both webs dull white basally (except no. 10), but white more extensive and more abruptly defined on outer web; some individuals, especially females, with white areas indefinitely outlined; primaries 4, 3, 2, and 1 with progressively broader tippings of tilleul buff; secondaries dull black fading basally on margin of inner web to light gray; tips of outer secondaries tilleul buff changing to clay color on inner members of series; tipping most extensive on secondaries 6, 7, and 8; borders of clay color tips irregular, small spots of brown occasionally appearing near, but separate from, tip; greater primary coverts dull black, each narrowly tipped with drab; greater secondary coverts dull black with wood brown tips and wood brown median, subterminal spots or bars; middle coverts and dorsal marginal coverts of wrist and forearm spotted with wood brown or drab; feathers of alula margined with tilleul buff and drab; marginals of hand and axillars white; under wing coverts dark neutral gray.

Tail: four median rectrices dull black with clay color tips 4 to 5 mm. long; remaining rectrices tipped with white as in adults although white tipping averaging less extensive; bases of rectrices as in adults.

Bill and feet various shades of brown and flesh color depending on age. Dimensions after growth is complete same as those given for first-year birds.

Distribution.—Breeding range: incompletely known; eastern North America north of the United States, probably west through northern Ontario along the shores of Hudson Bay. Known to breed in Labrador and northern Quebec but probably not much south of latitude 52°. No dependable summer records are known to exist for the United States and southern Canada.

Winter range: south into northeastern United States and southeastern Canada irregularly as far as Virginia, Kentucky, and southern Illinois. Birds are known to winter in the Hudson Bay region (see distribution map, fig. 13). There is a record for the Bermuda Islands (Jones, 1859).

Comparisons.—*L. e. borealis* differs from *L. ludovicianus* as follows: black facial mask not continuous across base of culmen; under parts of postjuvenal birds vermiculated with narrow, well defined, dusky bars; wing more than 107.0 mm. in length; bill longer than 13.0 mm. whereas bill of *L. ludovicianus* usually less; weight 30 per cent greater (other lesser differences not listed).

L. e. borealis differs from *L. e. invictus* in postjuvenal plumages as follows: dorsal coloration of adults darker, usually between pale neutral gray and light neutral gray instead of between pallid neutral gray and gull gray as in *invictus;* browns and drabs of first-year birds averaging slightly darker; white superciliary line less prominent; lower rump and upper tail coverts usually gray, not pure white as in *invictus;* vermiculations on breast, flanks, and belly on the average more extensive; wing and tail 2 to 4 per cent shorter; amount of white on primaries 2 per cent less; amount of white on outer rectrices 10 to 20 per cent less; tarsometatarsus 3 to 4 per cent shorter; juveniles darker above and below.

L. e. borealis differs from *L. e. excubitor* in postjuvenal plumages as follows: upper parts darker, not pallid neutral gray; under parts extensively vermiculated in adults; white spot usually present on lower eyelid; bases of secondaries not white; outer rectrices not entirely white (other lesser differences not listed).

Remarks.—*Borealis* does not intergrade with *L. e. excubitor.* Intergradation between *borealis* and *invictus* probably occurs in northern Manitoba and in Keewatin. An immature specimen from Fort Churchhill, Manitoba, taken in July may be considered intermediate between the two races although its dimensions are those of *invictus.* The identification of winter specimens taken from the Mississippi Valley is difficult, for the distinctions between the races are based on average differences only. Birds of both races may be found throughout most of the northern Mississippi Valley as well as intermediate types, which doubtless come from the region of intergradation in breeding territories directly to the north. The similarity in color

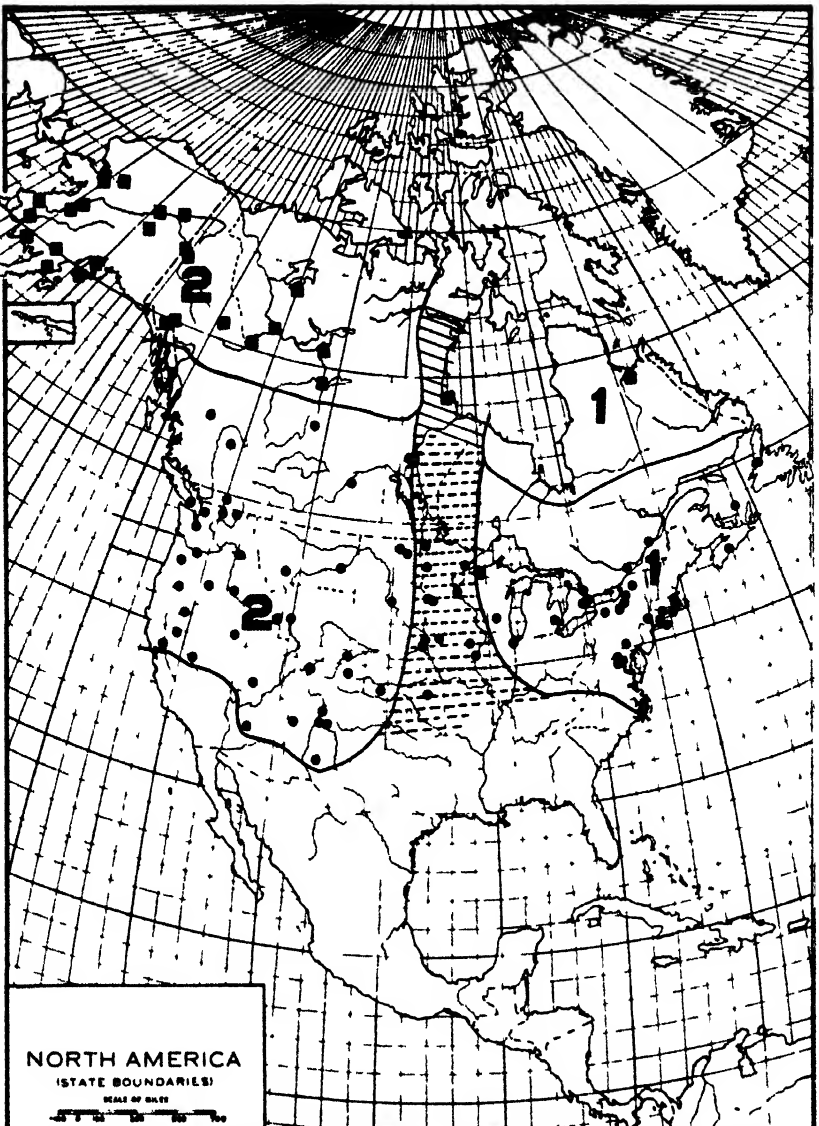

Fig. 13. Distribution of *Lanius excubitor* in North America. 1, *L. excubitor borealis*; 2, *L. excubitor invictus*. Dots indicate localities from which I have examined specimens of winter or migrating birds; squares indicate localities from which specimens of breeding birds have been examined. Zone of intergradation between breeding ranges of races indicated by shading with unbroken lines; zone of intermingling of races in winter indicated by shading with broken lines.

between some Alaskan birds and *borealis* of eastern North America I find to apply only to first-year individuals, the adults showing fairly constant differences. I cannot agree with Swarth (1926, pp. 135, 136) that it is impossible to define the boundary between the eastern and western races of this species, difficult as it is to identify some winter specimens. The boundary line between the breeding ranges is poorly known, I believe, only as a result of the extremely meager collections of breeding birds from critical localities.

No intergradation whatsoever occurs between *L. excubitor* and the distinctly separate species *ludovicianus,* contrary to the suggestion by Hartert (1910, p. 423) that the two are sufficiently similar to be included in the same species.

Lanius excubitor invictus Grinnell

Lanius excubitor, Forster (1771, p. 9).
Lanius borealis Vieillot (1807 [1808], p. 80), part.
Lanius septentrionalis, Shaw (1809, p. 331).
Collyrio borealis, Baird (1858, p. 324).
Collurio borealis, Baird (1866, p. 440).
Lanius borealis americanus Bogdanow (1881, p. 102), part.
L(anius). excubitor, forma borealis, Collett (1886, p. 40), part.
Lanius borealis invictus Grinnell (1900, p. 54), original description.
Lanius excubitor borealis, Schiebel (1906, p. 61), part.

Type.—Male first-year; no. 36915, Mus. Vert. Zool.; junction of Hunt and Kowak rivers, Alaska; April 15, 1899; collected by J. Grinnell; orig. no. 3366. Measurements: wing length, 116.5 mm.; white on primaries, 55.0 per cent of wing length; tail length, 113.7 mm.; white tip on outermost rectrix, 38.6 per cent of tail length; bill length, 13.9 mm.; bill depth, 9.0 mm.; bill width, 6.0 mm.; tarsometatarsal length, 26.5 mm.; middle toe, 12.1 mm.; hind toe, 9.2 mm.

Diagnosis.—Descriptions of corresponding plumages of *L. e. borealis* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: white superciliary line prominent; posterior part of forehead, crown, occiput, hind neck, back, and upper rump between pallid neutral gray and gull gray; lower rump and upper tail coverts white or gull gray. Under parts: chin, throat, and malar region white; vermiculations usually, but not always, limited to breast and sides. Wings: length, 118.00 mm.; white on primaries, 55.4 per cent of wing length. Tail: length, 117.59 mm.; white on outer rectrix, 42.4 per cent of tail length; ratio of wing to tail, 1.003:1. Feet: tarsometatarsal length, 27.14 mm.; middle toe, 12.55 mm.; hind toe, 9.74 mm.

Females, adult, breeding plumage.—Upper parts: head and back between pale neutral gray and gull gray. Wings: length, 113.00 mm.; white on primary, 53.4 per cent of wing length. Tail: length, 113.00 mm.; white on outer rectrix, 35.2 per cent of tail length. Feet: tarsometatarsal length, 27.36 mm.; middle toe, 12.37 mm.; hind toe, 9.82 mm.

Females, adult, fall plumage.—Feathers of back occasionally tipped with light mouse gray.

Males, first-year, breeding plumage.—Upper parts: crown, occiput, hind neck, back, and upper rump ranging from between pallid neutral 'ay and gull gray to light mouse gray; rump occasionally tinged with illeul buff. Wings: length, 115.75 mm.; white on primary, 54.3 per cent of wing length. Tail: length, 114.75 mm.; white tip on outer rectrix, 36.9 per cent of tail length. Feet: tarsometatarsal length, 27.03 mm.; middle toe, 12.32 mm.; hind toe, 9.65 mm.

Males, first-year, fall plumage.—Forehead, pileum, and back usually drab, rarely wood brown.

Females, first-year, breeding plumage.—Wings: length, 114.88 mm.; white on primaries, 53.3 per cent of wing length. Tail: length, 112.98 mm.; white tip on outer rectrix, 32.17 per cent of tail length. Feet: tarsometatarsal length, 26.88 mm.; middle toe, 12.24 mm.; hind toe, 9.57 mm.

Juveniles.—Upper parts. pileum, hind neck, and upper rump between smoke gray and light drab; back and scapulars drab; lower rump and base of upper tail coverts smoke gray extensively tipped with drab. Under parts: throat, breast, flanks, and upper belly smoke gray, each feather with two fine dusky bars; lower belly and under tail coverts white, the latter tipped or barred with a single dusky band.

Distribution.—Breeding range: western North America including Mackenzie, Yukon, northern British Columbia, Alaska, and extreme northern Saskatchewan and Alberta.

Winter range: south into northwestern United States, southwestern Canada and southern Alaska irregularly as far as Central California, Arizona, New Mexico, and Texas.

Comparisons.—For comparisons with *L. e. borealis* see page 50.

According to Hartert (1910, p. 423) *L. e. invictus* differs from *L. e. mollis* as follows: upper parts purer gray; rump grayer and without rusty yellow tinge; wing shorter; white or gray border of the alula less prominent.

Remarks.—No specimens of *mollis* have been examined by me but judging from the descriptions and comparisons given by several authors, there is a pronounced intergradation involving the characters which serve to separate *mollis* from *invictus* (see A. H. Miller, 1930*b*, pp. 163, 164). That there are valid subspecific differences between the two seems to be indicated by the literature.

For a discussion of intergradation with *borealis* see pages 51 and 52.

Lanius ludovicianus ludovicianus Linnaeus

(*Lanius*) *ludovicianus* Linnaeus (1776, p. 134), original description, based on Brisson (1760, p. 162).

Lanius ardosiaceus Vieillot (1807 [1808], p. 81).

Lanius carolinensis Wilson (1811, p. 57).

Collyrio ludovicianus, Baird (1858, p. 325).

Collurio ludovicianus, Baird (1866, p. 443).

(*Collurio ludovicianus*) var. *ludovicianus*, Baird, Brewer, and Ridgway (1874, p. 418), part.

(*Lanius ludovicianus excubitorides*) a. *ludovicianus*, Coues (1878, p. 561), part.

(*Lanius ludovicianus*) a. *ludovicianus*, Ridgway (1889, p. 194), part.

Lanius ludovicianus ludovicianus, Palmer (1898, p. 248).

Type.—No specimen is known to exist which can be considered as the type. The birds which Brisson (1760, p. 162) used in describing *L. ludovicianus* were sent to France from the old Louisiana Territory by Count de la Galissonière. Brisson's description later formed the basis for Linnaeus' characterization (1766, p. 134) of *Lanius ludovicianus*. In Brisson's account of this bird, mention was made of white upper tail coverts, but this statement was not repeated by Linnaeus, probably because of the shortened form of description used by the latter author. At my request, M. Jacques Berlioz, of the Muséum National d'Histoire Naturelle, kindly searched in the Paris museum for a possible type of this species but without success. He states that Count de la Gallissionière was not an explorer but most probably a French official in the old Louisiana colony. He believes it is possible that the specimens sent by Galissonière came from the lower Mississippi Valley, the headquarters of the colony. From the foregoing it may be seen that the birds that Brisson examined might have been either *migrans*, which winters in abundance in the present state of Louisiana, *excubitorides* from the western part of the Louisiana Territory, or *L. l. ludovicianus*, the breeding bird of the Gulf Coast. Parts of Brisson's description would seem to apply to *excubitorides* or to *migrans*, the latter race, occasionally, also possessing a whitish rump. However, the description may not have been exact in its color designation, in which case the probability that the birds were taken in the present state of Louisiana would point to their being either *migrans* or *L. l. ludovicianus*. In view of the apparent impossibility of a conclusive decision as to which of the three races mentioned should bear the name *L. l. ludovicianus*, I feel that it is highly desirable to conserve the current usage of these names rather than confuse the nomenclature with changes which could not be based on well proved facts.

Description.—Males, adult, breeding plumage.—Upper parts: anterior forehead neutral gray fading gradually to pale neutral gray along border of facial mask; dull white superciliary line narrow; posterior forehead, crown, occiput, hind neck, and back between deep mouse gray and neutral gray; outer scapulars pallid neutral gray

with narrow white margins; rump and upper tail coverts uniform neutral gray, the latter often possessing black tips or spots; frontal tufts usually entirely black; lores, entire ocular region below superciliary line, auricular region, and usually some adjacent feathers of neck black, together forming a continuous black facial mask.

Under parts: either entirely white or sides and flanks pallid neutral gray and breast occasionally with extremely faint, poorly defined vermiculations.

Wings: primaries black, numbers 1 to 4 tipped with white; bases of primaries, except tenth, white on both webs, forming a distinct basal white patch; either seventh or eighth primary longest, usually the former; fifth usually longer than ninth primary; secondaries black, gray basally on margin of inner web and tipped with white, most extensively on numbers 7 and 8; primary coverts black; greater and middle secondary coverts black with minute white median terminal dots frequently lost through wear; alula black, narrowly margined with gray; upper marginal coverts of wrist and ulna black, broadly tipped with neutral gray; marginal coverts of hand white; axillars and under marginal coverts pallid neutral gray and white; under wing coverts dark neutral gray; wing length, 96.98 mm.; white on primaries, 54.5 per cent of wing length.

Tail: rectrices black tipped with white except middle pair which may or may not possess minute median terminal dots; white tips of central rectrices frequently lost through wear; outer web of outermost rectrix, number 6, entirely white; outer web of rectrix number 5 partly or entirely white; bases of rectrices usually white except middle pair; tail length, 102.77 mm.; white tip on outer rectrix, 39.2 per cent of tail length; ratio of wing to tail, 0.943:1.

Bill: large, thick; hook long and relatively slightly curved; color entirely black in dried skins; length, 12.36 mm.; depth, 8.83 mm.; width, 6.39 mm.

Feet: planta tarsum not segmented; tarsometatarsus and dorsal surface of toes black in dried specimens; tarsometatarsus relatively short; length, 26.83 mm.; middle toe, 12.91 mm.; hind toe, 9.94 mm.

Iris: brown.

Males, adult, fall plumage.—Same as breeding plumage except bill, especially lower mandible, various shades of dark brown instead of pure black.

Females, adult, breeding plumage.—Similar to males in breeding plumage but averaging slightly darker gray on head and back; black at base of culmen less extensive or replaced in middle line by a few gray feathers. Under parts more frequently with pallid neutral gray and traces of vermiculations. Wings: shorter with less white; length, 93.89 mm.; white on primaries, 53.8 per cent of wing length. Tail: shorter with less white; length, 99.37 mm.; white tip on outer rectrix, 37.6 per cent of tail length; ratio of wing to tail, 0.944:1. Bill: smaller; length, 12.02 mm.; depth, 8.65 mm.; width, 6.32 mm. Feet: slightly smaller than males; tarsometatarsal length, 26.48 mm.; middle toe, 12.70 mm.; hind toe, 9.59 mm.

Females, adult, fall plumage.—Same as breeding plumage except bill brown as in male adults in fall.

Males, first-year, breeding plumage.—Similar to male adults but averaging slightly darker gray above. Under parts more frequently tinged with gray and faintly vermiculated. Wings: outer secondaries, all or part of primaries, and primary upper coverts juvenal; alula either juvenal or renewed at first fall molt; remainder of wings renewed at first fall molt, coloration same as in adults; length shorter, but to a varying degree dependent on extent of first fall molt; white less; length, group A (see p. 26), 95.88 mm.; white on primaries, group A, 54.1 per cent of wing length; length, group B, 94.75 mm.; white on primaries, group B, 52.7 per cent of wing length. Tail: rectrices renewed at first fall molt, or partly or entirely juvenal; usually shorter than in adults; length, group A (see p. 28), 100.96 mm.; white tip on outer rectrix, group A, 38.4 per cent of tail length; length, group B, 94.75 mm.; white on outer rectrix, group B, 39.4 per cent of tail length. Dimensions of feet and bill similar to adults (see tables 3–8).

Males, first-year, fall plumage.—Similar to breeding first-year males. Under parts variable, ranging from white as in adult males to pallid neutral gray with distinct, but poorly defined, vermiculations, the latter more commonly encountered during early fall (see p. 16). Bill color various shades of brown, frequently flesh color at base of mandibles.

Females, first-year, breeding plumage.—Similar to males, first-year in breeding plumage but averaging slightly darker both above and below. Wings: smaller, white on primaries less extensive; length, group A, 95.20 mm.; white on primaries, group A, 53.6 per cent of wing length; length, group B, 92.43 mm.; white on primaries, group B, 52 2 per cent of wing length. Tail: shorter and with less white; length, group A, 99.09 mm.; white tip on outer rectrix, group A, 34.0 per cent of tail length; length, group B, 95.75 mm.; white tip on outer rectrix, group B, 34.6 per cent of tail length. Bill and feet similar to adult females (see tables 3–8).

Females, first-year, fall plumage.—Similar to first-year breeding females but averaging slightly darker and more frequently possessed of distinct vermiculations on breast. Auricular region occasionally hair brown rather than black. Bill various shades of brown, frequently flesh color at base of mandibles.

Juveniles.—Coloration of plumage highly variable, the following description indicating the average condition. Upper parts: pileum and hind neck smoke gray, each feather with two dusky bars; back olive gray, each feather usually with narrow smoke gray tip and a dusky bar; lateral scapulars dull white distally, each with a distinct bar near tip followed by a less distinct bar proximally; the more median scapulars (not the interscapulars) and bases of lateral scapulars light olive gray; rump and upper tail coverts light drab or clay color, each feather with two dusky bands; frontal tufts gray; bristles black; lores gray; antorbital, suborbital, and auricular regions varying from dull black to hair brown.

Under parts: chin and throat white; malar region vermiculated with dusky and frequently sparingly tipped with black; breast, sides, and flanks light smoke gray, each feather with two dusky bars; belly and under tail coverts white with dusky spots and bars occasionally occurring on tips.

Wings: primaries dull black, both webs white basally (except outer web of no. 10) but with white more abruptly defined on outer web; primary 5 slightly tipped with light buff, primaries 4, 3, 2, and 1 with progressively broader dull white tips; secondaries dull black fading basally to gray on margin of inner webs; tips of distal secondaries dull white changing to vinaceous buff or cinnamon buff on inner secondaries; border between buff and black on inner secondaries usually irregular; secondaries 8 and 9 often with small buff spots near, but separate from, tip; primary coverts dull black, each tipped with buff or dull white; greater secondary coverts with clay color tips and median subterminal dots or bars; all middle and upper marginal coverts of forearm similarly tipped and barred with cinnamon buff or clay color; alula bordered with tilleul buff; marginals of hand, under marginals of forearm, and axillars white; greater and middle under coverts dark neutral dusky.

Tail: four middle rectrices black, with 2.0 mm. tips of clay color or cinnamon buff, frequently with a subterminal buff dot separate from tip; other rectrices black, extensively but unequally tipped with light buff or white, rarely possessing median buff dots; outer web of outermost rectrices entirely buff or white.

Bill and feet various shades of brown and flesh color depending on age.

Distribution.—Permanent resident of the Gulf Coast and southern Atlantic states from middle Louisiana (locally distributed in the pine forest areas) eastward through Mississippi and Alabama, south of about latitude 33°, to Florida and Georgia, except for the northwest mountainous region of the latter; northeastward through South Carolina, North Carolina, and Virginia, southeast of the Alleghany Mountains, at least to Nelson County, Virginia.

There are no certain records of the species on the Bermuda Islands or in Cuba.

Comparisons.—For comparisons with *L. e. borealis* see page 50.

L. l. ludovicianus differs from *L. l. migrans* in postjuvenal plumages as follows: anterior forehead with restricted light gray area; pileum, hind neck, and back averaging darker, between neutral gray and deep mouse gray; scapulars averaging slightly less white on tips; rump always uniform neutral gray; breast, sides, and flanks occasionally pallid neutral gray with faint vermiculations. Wing 1 to 2 per cent shorter; tail 2 to 4 per cent longer; white tip on outer rectrix slightly smaller; wing averaging decidedly shorter than tail. Bill larger, hook longer but less acutely curved; length and depth 4 to 7 per cent greater; width 5 per cent greater.

Remarks.—*L. l. ludovicianus* intergrades with *migrans* in northern Virginia along the valley of the Potomac River. Breeding specimens from Maryland are referrable to *migrans*, yet some show intermediate characters of color and tail length. As far as can be learned, the mountains which bound *L. l. ludovicianus* to the northwest constitute a zone in which shrikes are rare or are entirely absent. Intergradation in this region, although possibly occurring to a limited extent, is not demonstrated in the collections available for examination. Intergradation occurs in northern Mississippi and Alabama, extreme southeastern Arkansas, and in northern Louisiana.

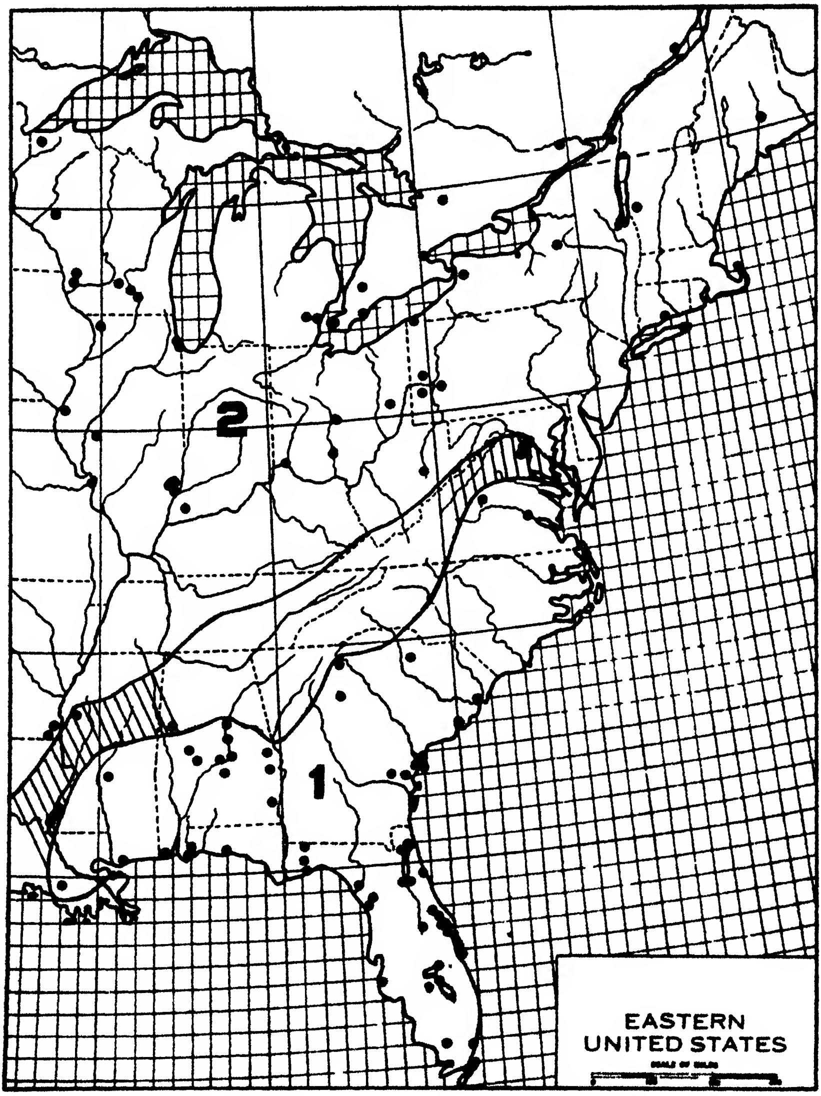

Fig. 14. Breeding ranges of Loggerhead Shrikes (*Lanius ludovicianus*) in the eastern United States. 1, *L. l. ludovicianus*; 2, *L. l. migrans*. Dots indicate localities from which I have examined specimens of breeding or permanently resident birds. Zones of intergradation between races indicated by shading.

Along the Gulf Coast in eastern Texas and western Louisiana there are no records of breeding shrikes. Thus, *L. l. ludovicianus* is separated geographically from *L. l. excubitorides* (Ragsdale, 1889) and, accordingly, does not intergrade with it.

Lanius ludovicianus migrans W. Palmer

Lanius excubitroides Peabody (1839, p. 292).
Lanius ludovicianus, Woodhouse (1853, p. 76).
Lanius excubitoroides, Hoy (1853, p. 308).
Collyrio excubitoroides, Baird (1858, p. 327), part.
Collurio excubitoroides, Baird (1866, p. 445), part.
Collurio ludovicianus, Allen (1868, p. 495).
(*Collurio ludovicianus*) Var. *excubitoroides*, Coues (1872, p. 125), part.
Collyrio ludovicianus, Trippe (1873, p. 235).
Lanius ludovicianus excubitorides, Coues (1878, p. 561), part
Lanius ludovicianus excubitoroides, Merriam (1881, p. 228), part.
(*Lanius ludovicianus*) b. *excubitorides*, Ridgway (1889, p. 194), part.
Lanius ludovicianus migrans Palmer (1898, p. 248), original description.

Type.—Male adult (may be first-year), no. 163077, U. S. Nat. Mus.; Kingston, Ontario, Canada; April 4, 1898; collected by C. K. Clarke. Measurements as given by Palmer in inches and translated into millimeters: wing, 99.0 mm.; tail, 96.0 mm.; culmen (not equivalent to bill length, see p. 33), 13.6 mm.; tarsometatarsus, 27.2 mm.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: anterior part of forehead pallid neutral gray fading to white at margin of facial mask; posterior forehead, crown occiput, hind neck, and back between neutral gray and light mouse gray; white margins of scapulars averaging slightly more extensive than in *L. l. ludovicianus;* lower rump and upper tail coverts occasionally pallid neutral gray (rarely so in fresh, unfaded plumage); posterior part of black facial mask limited to auricular region. Under parts: breast, sides, and flanks usually pallid neutral gray, only occasionally with faint vermiculation. Wings: primary number 8 usually longest; length, 98.42 mm.; white on primary, 54.9 per cent of wing length. Tail: relatively short; length, 98.25 mm.; white tip on outer rectrix, 42.0 per cent of tail length; ratio of wing to tail, 1.001 :1. Bill: small; hook short and moderately curved; length, 11.38 mm.; depth, 8.24 mm.; width, 6.02 mm.

Females, adult, breeding plumage.—Under parts: breast, sides, and flanks pallid neutral gray occasionally with faint vermiculations. Wings: length, 97.83 mm.; white on primaries, 54.6 per cent of wing length. Tail: length, 97.52 mm.; white tip on outer rectrix, 37.7 per cent of tail length. Bill: longer than males, perhaps owing to random sampling; length, 11.60 mm.; depth, 8.20 mm.; width, 5.95 mm.

Males, first-year, breeding plumage.— Wings: outer secondaries, primary upper coverts and usually all the primaries juvenal; alula usually juvenal; length, group B, 97.83 mm.; white on primaries, group B, 54.3 per cent of wing length. Tail: length, group B,

98.03 mm.; white tip on outer rectrix, group B, 42.0 per cent of tail length. Bill and feet similar to adult males.

Males, first-year, fall plumage.—Under parts: breast, sides, and flanks usually light neutral gray with distinct, but poorly defined, vermiculations.

Females, first-year, breeding plumage.—Wings: length, group B, 95.44 mm.; white on primaries, group B, 53.4 per cent of wing length. Tail: length, group B, 94.35 mm.; white on tip of outer rectrix, group B, 36.2 per cent of tail length. Bill and feet similar to adult females.

Juveniles.—Upper parts: pale buff or smoke gray tips of feathers of pileum and neck prominent, more so than in *L. l. ludovicianus;* smoke gray and olive gray of upper parts averaging lighter than in *L. l. ludovicianus.*

Distribution.—Breeding range: from the eastern border of the Great Plains (northeastern Texas, and eastern Kansas, Nebraska, North and South Dakota, and Manitoba) eastward, northwest of the Alleghany Mountains, to Maryland, thence east to the Atlantic Coast and north to New Brunswick; south in the Mississippi Valley to Arkansas, northern Mississippi, and possibly northwestern Louisiana; north in Canada to southern Manitoba, Ontario, and Quebec. The race is of irregular and local distribution in Tennessee, Kentucky, the north Atlantic states, New England, and along the northern borders of its range in Canada.

Winter range: south to Virginia, North Carolina, Mississippi, Louisiana, eastern Texas, and in small numbers to South Carolina, Georgia, Alabama, and the eastern coast of Mexico; birds occasionally remain through winter in the northern parts of the breeding territory but do not occur in numbers north of Oklahoma, Arkansas, Kentucky, and Maryland.

Comparisons.—For a comparison with *L. l. ludovicianus* see page 57.

L. l. migrans differs from *L. l. excubitorides* in postjuvenal plumages as follows: anterior part of forehead slightly darker gray; superciliary line less prominent; remainder of pileum, hind neck, back, and upper rump darker, between neutral gray and light mouse gray; outer scapulars not entirely white; lower rump and upper tail coverts not white but occasionally pallid neutral gray, rarely forming a distinct rump patch lighter than the back; breast, sides, and flanks darker, usually pallid neutral gray; white margins and tips of wing coverts less prominent; wings 1 to 2 per cent shorter; tail 1 to 2 per cent shorter; tarsometatarsus and toes 1 to 3 per cent shorter.

Remarks.—The zone of intergradation between *migrans* and *excubitorides* is unusually broad. Birds from Wisconsin and Illinois often show a trend toward the *excubitorides* type whereas *excubitorides* in its pure form is not found breeding east of longitude 100°. Thus, there are many specimens from the Mississippi Valley which cannot be identified satisfactorily, a condition encountered in many species of birds in this region. Any exact boundary line between the two races must be arbitrarily chosen. It is valuable to the student of geographic variation to study and record under subspecific names such extensively intergrading forms as *migrans* and *excubitorides.* From

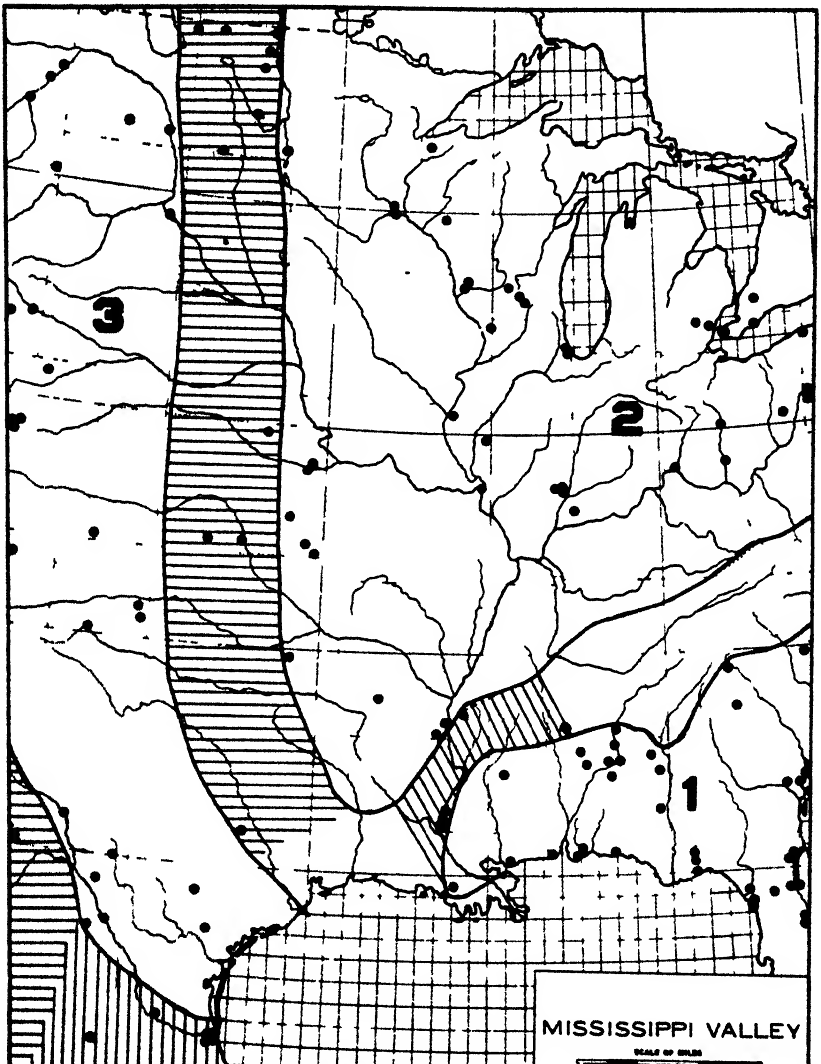

Fig. 15. Breeding ranges of Loggerhead Shrikes (*Lanius ludovicianus*) in the central United States. 1, *L. l. ludovicianus*; 2, *L. l. migrans*; 3, *L. l. excubitorides*. Dots indicate localities from which I have examined specimens of breeding or permanently resident birds. Zones of intergradation between races indicated by shading.

my point of view, however, it matters little whether or not intermediates are definitely assigned to one form or the other of the races in question. For the purpose of cataloguing such intermediate specimens, identification by means of geographic locality combined with some consideration of the characters of the individual specimen would seem to constitute the best mode of procedure.

See page 57 for a discussion of intergradation with *L. l. ludovicianus.*

Lanius ludovicianus excubitorides Swainson

Lanius excubitorides Swainson (1831 [1832], p. 115), original description.
Lanius excubitoroides Baird (1852, p. 328), part.
Collyrio excubitoroides, Baird (1858, p. 327), part.
Lanius ludovicianus, Maximilian (1858, p. 191).
Collyrio ludovicianus, Dresser (1865, p. 480).
Collurio excubitoroides, Baird (1866, p. 445), part.
(*Collurio ludovicianus*) Var. *excubitoroides*, Coues (1872, p. 125), part.
Collurio ludovicianus, B. *excubitoroides*, Ridgway (1877, p. 197).
Collurio ludovicianus excubitoroides, Sennett (1878, p. 16).
Lanius ludovicianus excubitorides, Coues (1878, p. 561), part.
Lanius ludovicianus excubitoroides, Allen and Brewster (1883, p. 160).
C(*ollurio*). *l*(*udovicianus*). *excubitorides*, Coues (1884, p. 338), part.

Type.—Description by Swainson based on a specimen taken at Carlton House (Carlton), Saskatchewan, Canada; collected in June, 1827. Presumably the specimen is now in the British Museum.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: anterior part of forehead pallid neutral gray fading to white at margin of black facial mask; white superciliary line prominent; remainder of pileum, hind neck, back, and upper rump between deep gull gray and light mouse gray; lower rump and upper tail coverts white; outer scapulars entirely white; posterior part of black facial mask limited to auricular region. Under parts: breast white; sides and flanks occasionally tinged with pallid neutral gray or pale buff, rarely with faint vermiculations. Wings: primary number 8 usually longest; alula conspicuously margined with white; length, 99.92 mm.; white on primary, 59.0 per cent of wing length. Tail: relatively short; length, 1000.00 mm.; white tip on outer rectrix, 42.1 per cent of tail length; ratio of wing to tail 0.999:1. Bill: small; hook short and moderately curved; length, 11.32 mm.; depth, 8.24 mm.; width, 5.92 mm. Feet: tarsometatarsus and toes moderately long; tarsometatarsal length, 27.4 mm.; middle toe, 13.13 mm.; hind toe, 10.13 mm.

Females, adult, breeding plumage.—Wings: length, 98.92 mm.; white on primaries, 57.3 per cent of wing length. Tail: length, 96.41 mm.; white tip on outer rectrix, 44.7 per cent of tail length (this figure probably higher than normal due to random sampling). Bill and feet same as in males.

Males, first-year, breeding plumage.—Under parts: usually same as adult males but perhaps averaging slightly grayer and more buffy.

Wings: outer secondaries, primary upper coverts, and usually all primaries juvenal; alula usually juvenal; length, group B, 97.73 mm.; white on primaries, group B, 57.7 per cent of wing length. Tail: length, group B, 99.14 mm.; white tip on outer rectrix, group B, 40.4 per cent of tail length.

Males, first-year, fall plumage.—Under parts: in early fall often with faint, pale buffy vermiculations, but later, similar to adults.

Females, first-year, breeding plumage.—Measurements not available in sufficient number to compile averages; wings and tail probably slightly smaller and less white than in first-year males in breeding plumage.

Females, first-year, fall plumage.—Under parts: in early fall often with faint, pale buffy vermiculations, but later, similar to adult females.

Juveniles.—Upper parts: pale buff or smoke gray tips of feathers of pileum and neck prominent, more so than in *L. l. ludovicianus*, but similar to *L. l. migrans;* smoke gray and olive gray of upper parts lighter than in *L. l. ludovicianus.* Under parts: vermiculations usually less prominent than in *L. l. ludovicianus.*

Distribution.—Breeding range: the Great Plains east of the Rocky Mountains from central Alberta, and Saskatchewan, south of latitude 54°, southward through western Texas, exclusive of the region of El Paso, to northern Coahuila, Nuevo Leon, and Tamaulipas; east to about longitude 100 in Manitoba, North and South Dakota, Nebraska, Kansas, and Oklahoma, but in Texas east to the vicinity of Austin and the mouth of the Colorado River, possibly as far as Houston (Nehrling, 1882, p. 11).

Winter range: eastern New Mexico and western Texas south through Mexico, exclusive of Sonora, Sinaloa, and western Chihuahua, to the Isthmus of Tehuantepec. In Mexico, however, it occurs principally in the northeast coast and plateau districts.

Comparisons.—For comparison with *L. l. migrans* see page 60.

L. l. excubitorides differs from *L. l. gambeli* in postjuvenal plumages as follows: anterior part of forehead with larger zone of pallid neutral gray: remainder of pileum, hind neck, back, and upper rump lighter gray, nearer gull gray; scapulars with more white, the outermost feathers entirely white; lower rump and upper tail coverts usually lighter, always white or pale gull gray; breast, sides, and flanks lighter and usually lacking any but faint vermiculations; white margins and tips of dorsal wing coverts more extensive; wing slightly longer; amount of white on primaries 2 to 5 per cent greater; tail 2 per cent shorter; white tip on outer rectrix 30 per cent greater; bill 2 to 5 per cent shorter and slightly narrower; hook of bill shorter and less acutely curved.

L. l. excubitorides differs from *L. l. nevadensis* as follows: pileum, hind neck, back, and upper rump nearer gull gray rather than neutral gray; under parts of first-year birds usually lighter with less buff and drab; amount of white on primaries about 2 per cent greater; tail 2 to 4 per cent shorter; white tip on outer rectrix 20 to 30 per cent greater; bill 5 to 7 per cent shorter; hook of bill shorter and less acutely curved.

L. l. excubitorides differs from *L. l. sonoriensis* as follows: pileum, hind neck, back, and upper rump nearer gull gray rather than neutral gray; under parts less immaculately white; wing 2 per cent shorter; amount of white on primaries about 2 per cent greater; tail 6 to 9 per cent shorter; white tip on outer rectrix 8 per cent greater; hook of bill shorter and less acutely curved; length 6 to 9 per cent shorter; bill depth 1 to 3 per cent less; bill width 1 to 4 per cent less; tarsometatarsus and toes about 1 per cent shorter.

L. l. excubitorides differs from *L. l. mexicanus* as follows: anterior part of forehead lighter; remainder of pileum, hind neck, back, and upper rump lighter, nearer gull gray rather than deep neutral gray or deep mouse gray; white rump area less extensive in adults, but similar in first-year birds; black mask limited posteriorly to auricular region; under parts in first-year birds lighter, nearer pure white, but similar in adults; coverts of tibiotarsus lighter, concolor with flanks; amount of white on primaries about 2 per cent greater, at least, in males; tail 3 to 6 per cent shorter; white tip on outer rectrix about 40 per cent greater; hook of bill less acutely curved; tarsometatarsus and toes larger, at least, in males.

Remarks.—*Excubitorides* intergrades with *gambeli* in the mountainous region of Montana, birds from the eastern foothills of the Rocky Mountains below 5000 feet elevation showing some of the dark coloration and other features of *gambeli*. Similar intergradation probably occurs in Wyoming but specimens from critical localities are not available.

Intergradation with *nevadensis* occurs in central Colorado along the continental divide and in northern New Mexico along the eastern border of the mountainous district.

Intergradation with *sonoriensis* takes place in the region between the Rio Grande and Pecos River in southern New Mexico and western Texas, and probably also in northern Coahuila.

Excubitorides intergrades with *mexicanus* in central Tamaulipas particularly in the region of Victoria, and probably at about the same latitude in Nuevo Leon and eastern Coahuila. Most of the breeding birds examined from northern Tamaulipas possess small white tips on the rectrices, however, although they lack the dark dorsal coloration of true *mexicanus*. Thus, the intergradation between these two races seems to occupy a considerable part of Tamaulipas and probably also a large part of Coahuila and Nuevo Leon.

For a discussion of intergradation with *migrans* see page 60.

Lanius ludovicianus mexicanus Brehm

Lanius carolinensis, Swainson (1827, p. 368).
Lanius ludovicianus, Bonaparte (1837, p. 112).
L(anius). mexicanus Brehm (1854, p. 145), original description.
Lanius excubitoroides, Sclater (1864, p. 173), part.
Collurio excubitoroides, Baird (1866, p. 445), part.
Lanius ludovicianus excubitorides, Cox (1895, p. 358), part.

Type.—No type specimen was designated by Brehm, and the locality was given as Mexico without further specification. Through the kindness of Dr. Erwin Stresemann, however, I have gained the

following information concerning specimens of this race in the Berlin Museum, the collections of which constituted the basis for most of Brehm's studies. In 1854, at the time of Brehm's description of *L. mexicanus,* there were but two specimens of the race in the Berlin collections, both taken by Ferdinand Deppe somewhere in Mexico and both now bearing the names *L. mexicanus* Brehm in Cabanis' handwriting. One specimen is molting from juvenal to adult (first-year) plumage, the other is an adult, and, according to Dr. Stresemann, is dark on the dorsal surface. The two specimens were undoubtedly used by Brehm for his description of *mexicanus* and may be considered tentatively as types. It does not seem likely that these supposed types could have come from the desert region in northwestern Mexico where the light-colored race *sonoriensis* is resident. Furthermore, the description given by Brehm without doubt applies to *mexicanus* as now known and not to either *excubitorides* or *sonoriensis.* Therefore, *mexicanus* is to be considered as the form resident in the southern part of Mexico.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Adults, male, breeding plumage.—Upper parts: superciliary line frequently not distinct but concolor with pileum; basal parts of vanes of feathers of back and pileum often black or dark gray; outer scapulars entirely white; upper tail coverts and a large part of rump white, abruptly contrasted with gray of back; black of facial mask often extending to feathers of neck and side of head adjacent to auricular region. Under parts: either entirely white or slightly tinged with gray on sides and flanks, vermiculations lacking. Wings: either primary 7 or 8 longest; wing length, 100.55 mm.; white on primaries, 56.55 per cent of wing length. Tail: length, 103.31 mm.; white tip on outer rectrix, 29.1 per cent of wing length; ratio of wing to tail, 0.973:1. Bill: small throughout; hook short, but strongly curved; length, 10.98 mm.; depth, 8.05 mm.; width, 5.78 mm. Feet: tarsometatarsus and toes small; tarsometatarsal length, 26.27 mm.; middle toe, 12.91 mm.; hind toe, 9.74 mm.

Females, adult, breeding plumage.—Breast and flanks frequently pallid neutral gray but lacking vermiculations. Measurements of wing, tail, bill, and feet not available in sufficient number to indicate with certainty the average condition. Measurements of five specimens show close similarity to males except for bill and tarsometatarsal length, which dimensions appear to be greater than in males but probably only as a result of the small sample of specimens at hand.

Males, first-year, breeding plumage.—Under parts usually white, but occasionally with pallid neutral gray as in female adults; white rump area not always sharply contrasted with gray of back. Average measurements not available.

Males, first-year, fall plumage.—Breast, sides, and flanks often tinged with pallid neutral gray or drab gray usually with drab gray or light drab vermiculations.

Females, first-year, breeding plumage.—Breast, sides, flanks, and upper belly pallid neutral gray. Average measurements not available.

Females, first-year, fall plumage.—Under parts similar to female first-year breeding plumage but with drab gray or light drab vermiculations.

Juveniles.—Upper parts: frontal tufts gray or black; tips of feathers of pileum and hind neck near vinaceous buff, vermiculated with dull black; back dark olive gray; inner scapulars and bases of lateral scapulars dark olive gray. Under parts: chin and throat with or without dusky vermiculations; breast and flanks varying from smoke gray to near vinaceous buff; sides deep olive gray; breast, sides, flanks, and upper belly with pronounced dusky vermiculations; coverts of tibiotarsus and under tail coverts usually vermiculated.

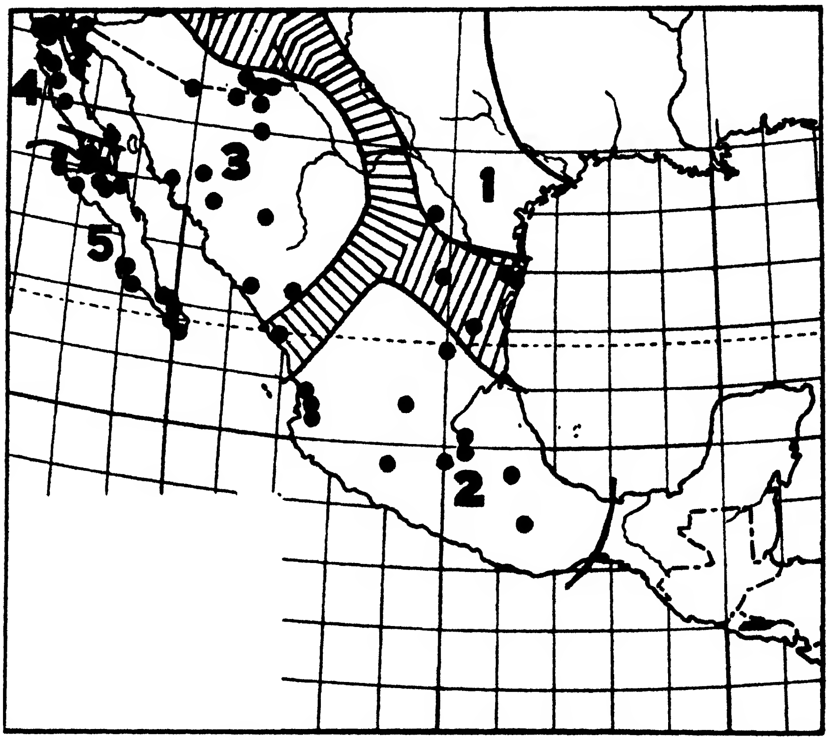

Fig. 16. Breeding ranges of Loggerhead Shrikes (*Lanius ludovicianus*) in Mexico. 1, *L. l. excubitorides*; 2, *L. l. mexicanus*; 3, *L. l. sonoriensis*; 4, *L. l. grinnelli*; 5, *L. l. nelsoni*. Dots indicate localities from which I have examined specimens of breeding or permanently resident birds. Zones of intergradation between races indicated by shading.

Distribution.—Permanent resident of central Mexico from southern Tamaulipas, southern Nuevo Leon, Zacatecas, Jalisco, and Tepic south through Vera Cruz and Oaxaca to the Isthmus of Tehuantepec.

Comparisons.—For comparisons with *L. l. excubitorides* see page 64.

L. l. mexicanus differs from *L. l. sonoriensis* in postjuvenal plumages as follows: anterior part of forehead with less pallid neutral gray; remainder of pileum, hind neck, back, and upper rump darker, between deep neutral gray and deep mouse gray; white of rump in adults more sharply contrasted with gray of back; black facial mask more extensive posteriorly; superciliary line lacking or less prominent;

under parts darker, especially in first-year birds; coverts of tibiotarsus darker; wing 1 to 2 per cent shorter; tail 2 to 3 per cent shorter; white tip on outer rectrix slightly smaller; bill about 10 per cent shorter, at least, in males; bill depth 4 to 5 per cent less; bill width 3 to 6 per cent less; tarsometatarsus 2 to 5 per cent shorter; middle toe 4 per cent shorter, at least, in males; hind toe 5 per cent shorter.

Remarks.—Judging from only a few specimens, *mexicanus* appears to intergrade with *sonoriensis* in the vicinity of Mazatlan in Sinaloa. Intergradation probably also occurs in northeastern Jalisco and Zacatecas.

For a discussion of intergradation with *excubitorides* see page 64.

Lanius ludovicianus sonoriensis A. H. Miller

Lanius ludovicianus, Henry (1855, p. 312).
Lanius excubitorides, Cassin (1857, p. 213), part.
Collyrio excubitoroides, Baird (1858, p. 327), part.
Collyrio ludovicianus, Henry (1859, p. 106).
Lanius excubitoroides, Heermann (1859, p. 55), part.
Collurio excubitoroides, Baird (1866, p. 445), part.
(*Collurio ludovicianus*) Var. *excubitoroides*, Coues (1872, p. 125), part.
Lanius ludovicianus excubitorides, Coues (1878, p. 561), part.
C(*ollurio*). *l*(*udovicianus*). *excubitorides*, Coues (1884, p. 338), part.
Lanius ludovicianus excubitoroides, Allen (1893, p. 40), part.
Lanius ludovicianus sonoriensis Miller (1930*a*, p. 155), original description.

Type.—Male adult, no. 54484, Mus. Vert. Zool.; Whitetail Cañon, elevation 5000 feet, Chiricahua Mountains, Cochise County, Arizona; April 15, 1915; collected by A. J. van Rossem; orig. no. 4204, coll. J. E. Law. Measurements: wing length, 103.3 mm.; white on primaries, 56.0 per cent of wing length; tail length, 110.0 mm.; white tip on outer rectrix, 36.2 per cent of tail length; bill length, 12.1 mm.; bill depth, 8.5 mm.; bill width, 6.3 mm.; tarsometatarsal length, 27.7 mm.; middle toe, 13.2 mm.; hind toe, 10.5 mm.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts; anterior part of forehead pallid neutral gray fading to white at margin of black facial mask; white superciliary line prominent; remainder of pileum, hind neck, back, and upper rump between light mouse gray and neutral gray; outer scapulars white; lower rump and upper tail coverts white; posterior part of facial mask limited to auricular region. Under parts: immaculate white throughout except for extreme dorsal part of sides which may be pallid neutral gray. Wings: eighth primary usually longest; alula conspicuously margined with white; wing, 102.09 mm.; white on primaries, 57.5 per cent of wing length. Tail: length, 106.69 mm.; white tip on outer rectrix, 34.5 per cent of tail length; ratio of wing to tail, 0.956:1. Bill: hook long and acutely curved; length, 12.31 mm.; depth, 8.45 mm.; width, 6.21 mm. Feet: tarsometatarsal length, 27.76 mm.; middle toe, 13.42 mm.; hind toe, 10.28 mm.

Females, adult, breeding plumage.—Under parts white as in males. Wings: length, 101.23 mm.; white on primaries, 56.6 per cent of wing length. Tail: length, 105.35 mm.; white tip on outer rectrix, 30.4 per cent of tail length. Bill: length, 11.93 mm.; depth, 8.34 mm.; width, 6.10 mm. Feet: tarsometatarsal length, 27.38 mm.; middle toe, 13.06 mm.; hind toe, 10.10 mm.

Males, first-year, breeding plumage.—Under parts usually similar to adults but occasionally tinged with pallid neutral gray and faintly vermiculated with light buff. Wings: outer secondaries and greater primary coverts juvenal; outer primaries usually not juvenal; length, group A, 101.31 mm.; white on primaries, group A, 56.1 per cent of wing length. Tail: rectrices renewed at first fall molt with rare exception; length, group A, 105.03 mm.; white tip on outer rectrix, group A, 32.1 per cent of tail length. Bill: length, group A, 12.06 mm.; depth, group A, 8.50 mm.; width, group A, 6.13 mm. Feet similar to adult.

Males, first-year, fall plumage.—Breast usually faintly vermiculated with light buff, especially during early part of fall.

Females, first-year, breeding plumages.—Wings: length, group A, 99.93 mm.; white on primaries, group A, 56.4 per cent of wing length. Tail: length, group A, 104.11 mm.; white tip on outer rectrix, group A, 30.4 per cent of tail length. Bill and feet similar to adult female.

Females, first-year, fall plumage.—Breast faintly vermiculated with light buff.

Juveniles.—Upper parts: tips of feathers of pileum and hind neck light smoke gray; smoke gray and olive gray of upper parts lighter than in *L. l. ludovicianus* but similar to *L. l. excubitorides*. Breast, sides, and flanks lighter, but more finely vermiculated than in *L. l. excubitorides* or *L. l. ludovicianus*.

Distribution.—Permanent resident from the Colorado Desert of California and Colorado Delta region of Lower California east through Arizona south of Mohave, Yavapai, Navajo, and Apache counties to southern Grant, Luna, and Dona Ana counties in New Mexico; southwest along the valley of the Rio Grande to Brewster County, Texas; and south through the states of Sonora, Chihuahua, northern Durango, and Sinaloa to the vicinity of Mazatlan.

Comparisons.—For comparisons with *L. l. excubitorides* and *L. l. mexicanus* see pages 64 and 66 respectively.

L. l. sonoriensis differs from *L. l. nevadensis* in postjuvenal plumages as follows: pileum, hind neck, back, and upper rump slightly lighter neutral gray; under parts in adults with less gray on sides; under parts in first-year birds lighter with less buff and drab; wing 2 to 3 per cent longer; tail 4 to 5 per cent longer; white tip on outer rectrix slightly greater; bill and feet slightly larger.

L. l. sonoriensis differs from *L. l. gambeli* as follows: anterior part of forehead with larger zone of pallid neutral gray; remainder of pileum, hind neck, back, and upper rump lighter gray; scapulars with more white laterally; lower rump and upper tail coverts usually lighter, always either white or pallid neutral gray; breast and flanks much lighter, usually lacking vermiculations except in first fall plumage; wing 2 to 4 per cent longer; white on primaries 1 to 4 per cent

greater; tail 4 to 6 per cent longer; white tip on outer rectrix about 5 per cent greater; bill 2 to 5 per cent longer; bill depth similar, but width greater; feet slightly larger.

L. l. sonoriensis differs from *L. l. grinnelli* as follows: anterior part of forehead with much more light gray; margin of facial mask white; superciliary line more prominent; posterior part of forehead, crown, occiput, hind neck, back, and upper rump much lighter gray; distal scapulars white; lower rump and tail coverts lighter, either white or pallid neutral gray; facial mask less extensive anterior to eye, limited to auricular region posteriorly; entire under surface, except for lower belly and under tail coverts, decidedly lighter; white tips on remiges and dorsal wing coverts more extensive; wing length 1 to 2 per cent greater; white on primaries 10 per cent greater, at least, in adult males; tail length 2 to 3 per cent greater; white tip on outer rectrix 30 per cent greater; hind toe 2 to 5 per cent greater.

Remarks.—Intergradation with *grinnelli* takes place north of San Felipe, Lower California, and probably also at points along the east side of the Sierra Juarez.

Gambeli intergrades with *sonoriensis* along the eastern margin of the mountains in San Diego County and again at San Gorgonio Pass, Riverside County, California, contrary to Bishop's contention (1927, pp. 78, 79) that such intergradation is lacking.

Nevadensis intergrades with *sonorienses* in southeastern San Bernardino County, California, and probably also in northern Arizona and west-central New Mexico, although suitable specimens are not available to show intergradation at these latter points. Breeding birds from the Tunitcha Mountains in extreme northeastern Arizona are referable to *nevadensis*. A series of young and immature birds from the San Francisco Mountains, Arizona, might be considered as intergrades inasmuch as they are darker than *sonoriensis* yet larger than most examples of *nevadensis*.

For a discussion of intergradation with *excubitorides* and *mexicanus* see pages 64 and 67 respectively.

Lanius ludovicianus grinnelli Oberholser

Lanius ludovicianus gambeli, Bryant (1889, p. 307), part.

Lanius ludovicianus grinnelli Oberholser (1919, p. 87); original description.

Type.—Adult (may be first-year) female, no. 196162 U. S. Nat. Mus., Biol. Surv. Coll.; San Fernando, Lower California; September 4, 1905; collected by E. W. Nelson and A. E. Goldman; orig. no. 11644.

Diagnosis.—Description of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: anterior part of forehead concolor with crown, or else slightly lighter gray; white or gray margin of black facial mask narrow; crown, occiput, hind neck, back, and upper rump between deep mouse gray and neutral gray as in *L. l. ludovicianus;* scapulars entirely pale, or pallid neutral gray, rarely with narrow margin of dull white laterally; lower rump and upper tail coverts pallid neutral gray or dull white, decidedly lighter

than back but not sharply contrasted with dark gray of upper rump. Under parts: chin dull white, bases of feathers dark gray; throat and malar region pallid neutral gray or dull white gradually darkening to drab gray on central part of breast; sides, sides of breast, flanks, and upper belly light neutral gray; traces of light neutral gray vermiculations occasionally visible on drab gray of breast; extreme posterior part of belly and under tail coverts white; coverts of tibiotarsus neutral gray. Wings: eighth primary usually longest; white tips on remiges small; axillars concolor with flanks; wing length, 101.04 mm.; white on primaries, 51.8 per cent of wing length. Tail: outer web of outer rectrix not always entirely white; tail length, 105.27 mm.; white tip on outer rectrix, 26.1 per cent of tail length; ratio of wing to tail, 0.959 :1. Bill: long, moderately thick; hook long and strongly curved; length, 12.30 mm.; depth, 8.51 mm.; width, 6.20 mm. Feet: tarsometatarsus long, 27.57 mm.; middle toe, 13.15 mm.; hind toe small, 9.68 mm.

Females, adult, breeding plumage.—Coloration same as adult males throughout. Dimensions probably slightly smaller than those of males.

Males, first-year, breeding plumage and fall plumage.—Coloration same as adult males throughout. Wings: a small number of outer secondaries and at least part of primary upper coverts juvenal; inner primaries juvenal, but outer primaries renewed at first fall molt probably with rare exception; length, group A, 99.90 mm.; white on primaries, group A, 54.63 per cent of wing length. Tail: length, group A, 102.77 mm.; white tip on outer rectrix, group A, 23.9 per cent of tail length (average measurements of wing and tail based on three specimens only). Bill and feet similar to adult males.

Females, first-year, breeding plumage and fall plumage.—Coloration same as adult males. Dimension probably smaller than those of either adult males or females.

Juveniles.—Upper parts: pileum, hind neck, back, and upper rump nearly uniform light mouse gray, feathers almost lacking smoke gray tips which in other subspecies make up predominant color of head and neck; vermiculations faint or absent on head, back, and rump. Under parts: breast, sides, flanks, and most of belly near pale drab gray; dusky vermiculations faint but extending relatively far posteriorly on belly; coverts of tibiotarsus and under tail coverts vermiculated with dusky.

Distribution.—Permanent resident of northern Lower California from slightly south of the United States boundary line on the Pacific coast, south to about latitude 29°; west of the Sierra Juarez but extending east to the Gulf coast south of latitude 31°.

Comparisons.—For comparisons with *L. l. sonoriensis* see page 69.

L. l. grinnelli differs from *L. l. nelsoni* in postjuvenal plumages as follows: anterior part of forehead usually concolor with crown; white or gray superciliary line less prominent; remainder of pileum, hind neck, back, and upper rump darker, between deep neutral gray and deep mouse gray; scapulars usually lacking pure white distally; lower rump and upper tail coverts darker, often pallid neutral gray rather than white; gray margin of black facial mask less prominent; under parts darker throughout, particularly breast and flanks; throat and belly with less white; coloration of postjuvenal plumages uniform

unlike those of *nelsoni;* wing with less white on remiges and alula; wing length 1 to 2 per cent greater; amount of white on primaries as much as 8 per cent less in adult males; tail 3 to 4 per cent longer; white tip on outer rectrix 10 to 15 per cent less; bill 2 to 5 per cent larger in all dimensions; feet, except for hind toe, slightly larger.

L. l. grinnelli differs from *L. l. gambeli* as follows: anterior part of forehead usually concolor with pileum; white or gray margin of facial mask and superciliary line less prominent; remainder of pileum, hind neck, back, and upper rump darker; scapulars darker, usually lacking pure white distally; breast, sides, and flanks darker with more neutral gray and less drab gray; throat and belly with less white; coverts of tibiotarsus darker gray; remiges and alula with smaller white tips and edges; wing length 1 to 2 per cent greater; white on primaries 2 to 4 per cent less; tail 3 to 4 per cent longer; white tip on outer rectrix 10 to 13 per cent less; bill length 4 to 6 per cent greater; bill width and depth slightly greater; hind toe 3 to 4 per cent shorter; tarsometatarsus slightly longer.

Remarks.—Intergradation occurs with *nelsoni* at Rosarito and Santo Domingo north of latitude 28°. A bird, no. 50972, Mus. Vert. Zool., from twenty miles south of Calmalli, farther inland and at about the same latitude as Rosarito, is referable to *nelsoni* although not entirely typical of this form. The zone of intergradation probably extends from these points north to about latitude 29° although specimens are not available from this area. A specimen reported by Townsend (1923, p. 22) as *gambeli* from Angel de la Guardia Island has been referred to *nelsoni* by Grinnell (1928, p. 194) but was not examined by him. I have had opportunity to examine the specimen which is a juvenile. It would seem to be close to *grinnelli* although positive identification of such juveniles is impossible.

Intergradation with *gambeli* occurs in the extreme northwestern part of Lower California along the United States boundary line. Birds from Nachogüero Valley and Las Palmas, Lower California, are decidedly intermediate between the two races. Certain specimens from San Diego, California, may be considered as intermediates between *gambeli* and *grinnelli*, not as specimens resembling *mearnsi*.

For a discussion of intergradation with *sonoriensis* see page 69.

Lanius ludovicianus nelsoni Oberholser

Collurio excubitoroides, Baird (1866, p. 445), part.

(*Collurio ludovicianus*) var. *excubitoroides*, Baird, Brewer, and Ridgway (1874, p. 421), part.

Lanius ludovicianus excubitorides, Belding (1883, p. 537), part.

Lanius ludovicianus gambeli, Bryant (1889, p. 307), part.

Lanius ludovicianus mearnsi Ridgway (1903, p. 108), part.

Lanius ludovicianus anthonyi, A. O. U. Check-list (1910, p. 297), part.

Lanius ludovicianus nelsoni Oberholser (1918, p. 209), original description.

Type.—Male adult (may be first-year), no. 196172, U. S. Nat. Mus., Biol. Surv. Coll.; Todos Santos, southern Lower California; December 26, 1905; collected by E. W. Nelson and E. A. Goldman; orig. no. 11885.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: pileum, except anterior part of forehead, hind neck, back, and upper rump near neutral gray; outer scapulars extensively tipped with white; lower rump and upper tail coverts white or pallid neutral gray. Under parts: chin, throat, and malar region white; breast, sides, flanks, and coverts of tibiotarsus pallid mouse gray, faintly vermiculated with pale neutral gray; belly and under tail coverts white. Wings: either primary 7 or 8 longest; white margin of alula prominent; wing length, 99.70 mm.; white on primaries, 54.0 per cent of wing length. Tail: length, 101.37 mm.; white tip on outer rectrix, 31.7 per cent of tail length; ratio of wing to tail, 0.993:1. Bill: long, hook long and acutely curved; length, 11.83 mm.; depth, 8.26 mm.; width, 6.07 mm. Feet: tarsometatarsal length, 27.48 mm.; middle toe, 13.40 mm.; hind toe, 9.98 mm. In general, size small as indicated by weight (see table 14).

Females, adult, breeding plumage.—Breast and flanks averaging slightly darker gray than in adult males, more vermiculated with pale drab gray. Wings: length, 96.02 mm.; white on primaries, 54.8 per cent of wing length. Tail: length, 98.52 mm.; white tip on outer rectrix, 31.4 per cent of tail length. Bill: length, 11.84 mm.; depth, 8.20 mm.; width, 5.94 mm. Feet: tarsometatarsal length, 26.55 mm.; middle toe, 12.93 mm.; hind toe, 9.61 mm.

Males, first-year, breeding plumage.—Under parts averaging slightly darker gray and more heavily vermiculated than in adult males. Wings: length, group A, 97.06 mm.; white on primaries, group A, 54.2 per cent of wing length. Tail: length, group A, 99.43 mm.; white tip on outer rectrix, group A, 26.8 per cent of tail length. Bill: length, group A, 12.21 mm.; depth, group A, 8.38 mm.; width, group A, 60.6 mm. Feet: tarsometatarsal length, group A, 27.05 mm.; middle toe, group A, 12.97 mm.; hind toe, group A, 9.88 mm.

Males, first-year, fall plumage.—Under parts similar to breeding plumage except during comparatively long period of fall molt when breast may be strongly vermiculated with drab gray.

Females, first-year, breeding plumage.—Wings: length, group A, 96.08 mm.; white on primaries, group A, 55.4 per cent of wing length. Tail: length, group A, 97.25 mm.; white tip on outer rectrix, group A, 26.7 per cent of tail length. Bill: length, group A, 11.74 mm.; depth, group A, 8.25 mm.; width, group A, 6.04 mm. Feet: tarsometatarsal length, group A, 26.67 mm.; middle toe, group A, 12.95 mm.; hind toe, group A, 9.63 mm.

Females, first-year, fall plumage.—Coloration similar to first fall males.

Juveniles.—Breast and flanks lighter, but more finely vermiculated, than in *L. l. ludovicianus.*

Distribution.—Permanent resident of central and southern Lower California from latitude 28° south to Cape San Lucas including Cedros and Santa Margarita islands and probably other adjacent islands wherever the species is resident. A specimen from Magdalena Island reported by Oberholser (1918, p. 210) as *gambeli* and a sight record

from Espiritu Santo Island by Nelson (1921, p. 92) possibly both apply to this subspecies.

Comparisons.—For comparisons with *L. l. grinnelli* see pages 70 and 71.

L. l. nelsoni differs from *L. l. gambeli* in postjuvenal plumages as follows: color of upper parts with less brown or drab, nearer pure neutral gray; rump averaging slightly lighter; under parts with more pallid mouse gray particularly on flanks and with less drab gray or brownish tinge; vermiculations less pronounced; size generally smaller except for bill (number of measurements of adult males too small to yield significant averages in all instances, statements of size differences being based largely on females and first-year males as compared with figures for *gambeli* from the vicinity of Los Angeles); wing 1 per cent shorter; tail 1 per cent shorter; bill 3 to 4 per cent longer; bill width and depth similar; tarsometatarsus 1 to 2 per cent shorter; middle toe 3 per cent shorter; hind toe 4 per cent shorter; weight 5 per cent less. White in wing and tail identical in amount, contrary to Oberholser's mention (1918, p. 209) of less white in *nelsoni*.

L. l. nelsoni differs from *L. l. nevadensis* as follows: under parts darker in adults with more pallid mouse gray or pallid neutral gray laterally, always with some faint vermiculations on center of breast; size generally smaller (comparison based on females and first-year males); wing 1 to 2 per cent shorter; white on primaries 3 to 4 per cent less; tail 2 per cent shorter; white on outer rectrix similar, although perhaps slightly less; tarsometatarsus 1 per cent shorter; weight 2 to 3 per cent less.

Remarks.—For a discussion of intergradation with *grinnelli* see page 71.

Mearnsi has been erroneously reported from Santa Margarita Island, Lower California, by Ridgway (1903, p. 108) before the time that *nelsoni* was described. *Mearnsi* may be readily distinguished from *nelsoni* by much darker upper parts, more conspicuously white rump, shorter wing, smaller amount of white on primaries, and much smaller bill.

Although *gambeli* and *nelsoni* do not intergrade geographically, there is an extensive overlapping in all the characters which serve to separate the two races. Consequently, it is extremely difficult to determine whether or not *gambeli* occurs in winter in southern Lower California. Oberholser (1918, p. 210) records *gambeli* from the Cape district in September, November (Magdalena Island), and January. I believe, however, that *gambeli* occurs rarely as a migrant within the range of *nelsoni*. *Gambeli* is non-migratory in most of California, and birds from Arizona, Washington, and Idaho appears to winter chiefly in Arizona, eastern California, and Sonora. Out of seventy-five skins taken from within the range of *nelsoni* at various seasons of the year and examined by me, none were found which might not be termed *nelsoni* with the exception of one winter-taken specimen, no. 13838, coll. D. R. Dickey, of *nevadensis* from La Paz. I have not had opportunity, however, to see the three specimens identified as *gambeli* by Oberholser.

No intergradation, geographically or structurally, occurs between *nelsoni* and *sonoriensis*.

Lanius ludovicianus nevadensis A. H. Miller

Lanius ludovicianus, Gambel (1847, p. 200).
Lanius excubitoroides Baird (1852, p. 328), part.
Lanius excubitorides, Cassin (1857, p. 213), part.
Collyrio excubitoroides, Baird (1858, p. 327), part.
Collurio excubitoroides, Baird (1866, p. 445), part.
(*Collurio ludovicianus*) Var. *excubitoroides*, Coues (1872, p. 125), part.
Collurio ludovicianus excubitoroides, Ridgway (1875, p. 11), part.
Collurio ludovicianus B. *excubitoroides*, Ridgway (1877, p. 453), part.
Lanius ludovicianus excubitorides, Coues (1878, p. 561), part.
Lanius ludovicianus excubitoroides, Drew (1881, p. 89), part.
C(*ollurio*). *l*(*udovicianus*). *excubitorides*, Coues (1884, p. 338), part.
Lanius ludovicianus nevadensis Miller (1930*a*, p. 156), original description.

Type.—Adult female, no. 22625, Mus. Vert. Zool.; Lone Pine Creek, elevation 4500 feet, Inyo County, California; April 11, 1912; collected by H. S. Swarth; orig. no. 9406. Measurements: wing length, 86.8 mm.; white on primaries, 55.0 per cent of wing length; tail length, 101.0 mm.; white tip on outer rectrix, 27.7 per cent of tail length; bill length, 11.3 mm.; bill depth, 8.2 mm.; bill width, 5.9 mm.; tarsometatarsal length, 26.0 mm.; middle toe, 13.3 mm.; hind toe, 9.6 mm.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: anterior part of forehead pallid neutral gray fading to white at margin of black facial mask; white superciliary line prominent; posterior part of forehead, crown, occiput, hind neck, back, and upper rump between neutral gray and mouse gray; outer scapulars, lower rump and upper tail coverts white; posterior part of facial mask limited to auricular region. Under parts: entirely white except for pallid neutral gray of sides. Wings: either primary 7 or 8 longest; alula conspicuously margined with white; length, 100.22 mm.; white on primaries, 57.1 per cent of wing length. Tail: length, 102.42 mm.; white tip on outer rectrix, 33.3 per cent of tail length; ratio of wing to tail, 0.978:1. Bill: moderately large; hook long and acutely curved; length, 12.10 mm.; depth, 8.35 mm.; width, 6.02 mm. Feet: tarsometatarsal length, 27.22 mm.; middle toe, 13.39 mm.; hind toe, 10.03 mm.

Females, adult, breeding plumage.—Under parts white as in males or tinged with extremely pallid neutral gray. Wings: length, 98.16 mm.; white on primaries, 56.3 per cent of wing length. Tail: length, 100.37 mm.; white tip on outer rectrix, 28.2 per cent of tail length. Bill: length, 11.82 mm.; depth, 8.15 mm.; width, 6.03 mm. Feet: tarsometatarsal length, 27.30 mm.; middle toe, 13.13 mm.; hind toe, 9.95 mm.

Males, first-year, breeding plumage.—Breast and flanks either white or tinged with pallid neutral gray and vermiculated with pale mouse gray. Wings: length, group A, 98.35 mm.; white on primaries, group A, 56.7 per cent of wing length. Tail: length, group A, 100.26 mm.; white tip on outer rectrix, group A, 30.5 per cent of tail

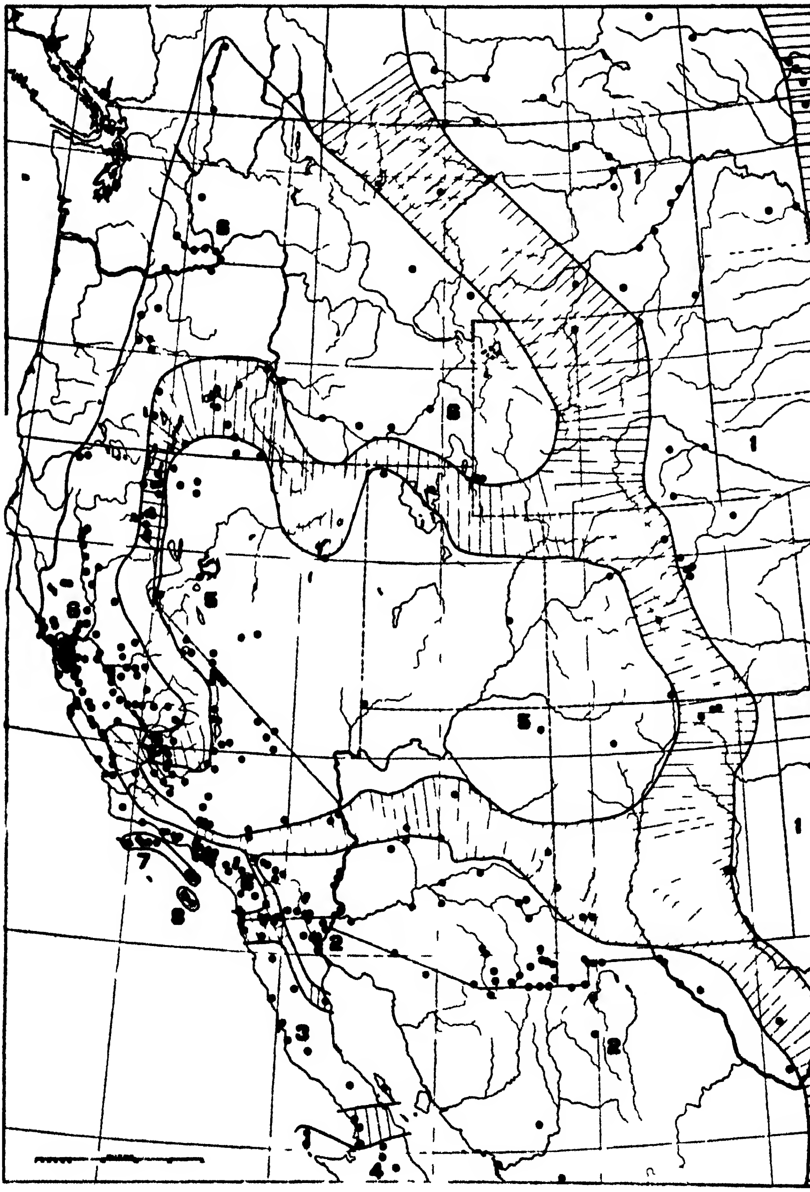

Fig. 17. Breeding ranges of Loggerhead Shrikes (*Lanius ludovicianus*) in the western United States. 1, *L. l. excubitorides*; 2, *L. l. sonoriensis*; 3, *L. l. grinnelli*; 4, *L. l. nelsoni*; 5, *L. l. nevadensis*; 6, *L. l. gambeli*; 7, *L. l. anthonyi*; 8, *L. l. mearnsi*. Dots indicate localities from which I have examined specimens of breeding or permanently resident birds. Zones of intergradation between races indicated by shading. See text for reference to records of *gambeli* west of the range of this race as here shown.

length. Bill: length, group A, 11.96 mm.; depth, group A, 8.26 mm.; width, group A, 6.01 mm. Feet: tarsometatarsal length, group A, 27.17 mm.; middle toe, group A, 13.05 mm.; hind toe, group A, 9.75 mm.

Males, first-year, fall plumage.—Breast and flanks occasionally tinged with pale drab gray, always vermiculated with pale mouse gray.

Females, first-year, breeding plumage.—Dimensions and amount of white in wing and tail slightly less than in first-year males; measurements not available in sufficient number to compile averages.

Females, first-year, fall plumage.—Breast and flanks always vermiculated with pale mouse gray and tinged with pale drab gray.

Juveniles.—Breast, sides, and flanks with heavier and finer vermiculations than those of *L. l. ludovicianus.*

Distribution.—Breeding range: from southern Harney and Malheur counties in southeastern Oregon south through western Nevada and in adjacent parts of California from Mono County southward, east of the Sierra Nevada (but including the Kern River basin in the southern San Joaquin Valley) to the north base of the Tehachapi, San Gabriel, and San Bernardino mountains and the vicinity of Needles in the Mohave Desert; east through northern Arizona to northwestern New Mexico and western Colorado west of the continental divide. The northeastern limits of the race in Utah and northeastern Nevada cannot be sharply defined owing to a lack of sufficient adult specimens from this state.

Winter range: remains in northern part of breeding range in small numbers, some individuals migrating south into the deserts of southern California, southern Arizona, southern New Mexico, northern Lower California and Sonora, and casually, to Michoacan and to La Paz, southern Lower California.

Comparisons.—For comparisons with *L. l. excubitorides, sonoriensis,* and *nelsoni* see pages 63, 68, and 73 respectively.

L. l. nevadensis differs from *L. l. gambeli* in postjuvenal plumages as follows: anterior part of forehead with larger zone of pallid neutral gray; remainder of pileum, neck, back, and upper rump lighter, nearer neutral gray rather than mouse gray as in *gambeli;* lower rump and tail lighter, either white or pallid neutral gray; breast and flanks lighter, usually white in adult plumages; under parts in first-year plumages similar, although averaging decidedly lighter; white on primaries 1 to 4 per cent greater; bill 2 to 4 per cent longer.

Remarks.—Intergradation with *gambeli* is known to occur in Tulare, Kings, and northern Los Angeles counties in southern California, in eastern Modoc and Lassen counties in northern California, and in Lake, northern Harney, and northern Malheur counties, Oregon.

For mention of intergradation with *sonoriensis* and *excubitorides* see pages 69 and 64 respectively.

Lanius ludovicianus gambeli Ridgway

Lanius ludovicianus, Ornithological Committee, Academy of Natural Sciences of Philadelphia (1837, p. 193).
Lanius elegans, Gambel (1843, p. 261), part.
Lanius excubitoroides Baird (1852, p. 328), part.
Lanius excubitorides, Sclater (1857, p. 126), part.
Collyrio excubitoroides, Baird (1858, p. 327), part.
Collurio excubitoroides, Baird (1866, p. 445), part.
Collurio ludovicianus, Allen (1871, p. 270).
(*Collurio ludovicianus*) Var. *excubitoroides*, Coues (1872, p. 125), part.
Lanius ludovicianus excubitorides, Coues (1875, p. 561), part.
Collurio ludovicianus B. *excubitoroides*, Ridgway (1877, p. 453), part.
Collurio ludovicianus B. *excubitorides*, Belding (1879, p. 411), part.
Lanius ludovicianus var. *excubitoroides*, Cooper (1880, p. 247), part.
L(anius). ludovicianus gambeli Ridgway (1887, p. 467), original description.

Type.—In the original description of *gambeli* no type specimen was designated and the locality mentioned was merely that of the known range of the subspecies, "California, especially coast district." At some time, a specimen in the United States National Museum has been marked as the type of *gambeli*, probably, but no means certainly, by Ridgway himself. This specimen is now no. 80468 U. S. Nat. Mus., and was collected by Lyman Belding in December 1877, but is without locality designation. In 1879 Belding (p. 411) listed the specimens of Loggerhead Shrike among other birds taken by him in central California and sent by him to the National Museum. Judging from the text of this article the list includes all the shrikes which he collected in 1877. In this paper there is only one shrike mentioned as having been secured in December 1877, which specimen was taken at Murphy's, Calaveras County. It is further stated that Belding collected at Murphy's from November 22 to December 22, 1877. Therefore, it would seem certain that the locality of this type was Murphy's were it not for the fact that the number on the type does not agree with the number given by Belding. The number in Belding's list is recorded in the United States National Museum register as destroyed in 1881. Nevertheless, the list includes other specimens the numbers for which, now on these same specimens, do not correspond to numbers as reported by Belding. Further, Belding has noted in the margin of a copy of this article belonging to Dr. Grinnell that there are numerous mistakes in the numbers of specimens as printed.

Judging, then, from the best evidence available, this lectotype, now no. 80464, was collected at Murphy's, 2400 feet elevation, Calaveras County, California. Apparently this specimen or the spoken word of Ridgway was the basis for the designation of the type locality as Calaveras County, California, in the American Ornithologists' Union Check-list, third edition (1910, p. 297).

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: anterior part of forehead and margin of black facial mask pallid neutral gray; remainder of pileum, hind neck, back, and upper rump between neutral gray and deep mouse gray as in *L. l. ludovicianus* although slightly darker and usually with more brown mixed with the gray; lower rump and upper tail coverts lighter than back varying from pale neutral gray to dull white, rarely pure white. Under parts: chin, throat, and malar region white; breast, flanks, upper belly, and coverts of tibiotarsus pale drab gray or pale smoke gray distinctly vermiculated with indefinite bands of pale or light mouse gray; sides light mouse gray. Wings: either primary 7 or 8 longest; (averages based on birds from western Los Angeles County) length, 99.62 mm.; white on primaries, 55.73 per cent of wing length. Tail: outer web of outer rectrix not always entirely white; length, 102.26 mm.; white tip on outer rectrix, 30.5 per cent of tail length; ratio of wing to tail, 0.974:1. Bill: moderately long; hook long and acutely curved; length, 11.94 mm.; depth, 8.37 mm.; width, 6.17 mm. Feet: tarsometatarsal length, 27.39 mm.; middle toe, 13.31 mm.; hind toe, 10.11 mm.

Females, adult, breeding plumage.—Similar to adult males in breeding plumage but averaging slightly darker and browner on upper parts and breast. Wings: shorter, but with same amount of white; length, 97.22 mm.; white on primaries, 55.8 per cent of wing length. Tail: length, 99.44 mm.; white tip on outer rectrix, 29.9 per cent of tail length. Bill: length, 11.58 mm.; depth, 8.30 mm.; width, 6.07 mm. Feet: tarsometatarsal length, 27.25 mm.; middle toe, 13.20 mm.; hind toe, 10.06 mm.

Males, first-year, breeding plumage.—Coloration same as adult males in breeding plumage. Wings: length, group A, 97.77 mm., group B, 96.28 mm.; white on primaries, group A, 55.8 per cent of wing length, group B, 56.0 per cent. Tail: shorter, but white tippings similar or relatively greater; length, group A, 99.18 mm., group B, 99.90 mm.; white tip on outer rectrix, group A, 32.2 per cent of wing length. Dimensions of bill and feet similar to adults.

Males, first-year, fall plumage.—Similar to breeding first-year males except during fall molt when under parts are darker and more heavily vermiculated than later in fall or in winter (see page 16).

Females, first-year, breeding plumage.—Similar to males in first-year breeding plumage but averaging slightly darker and browner above and below. Wings: shorter, but white on primaries similar; length, group A, 96.96 mm., group B, 95.34 mm.; white on primaries, group A, 55.6 per cent of wing length, group B, 54.6 per cent. Tail: length, group A, 97.61 mm., group B, 96.55 mm.; white tip on outer rectrix, groups A and B, 27.9 per cent of tail length. Dimensions of bill and feet similar to adult females.

Females, first-year, fall plumage.—Similar to first-year breeding females except during fall molt when under parts are darker and more heavily vermiculated than later in fall or in winter.

Juveniles.—Breast and flanks with heavier, although finer, vermiculations than in *L. l. ludovicianus*.

Distribution.—Breeding range: extreme southern British Columbia (Okanagan Lake); Montana, west of the Rocky Mountains including

the mountainous district above 5000 feet elevation in the southwestern part of the state drained by the Missouri River; Idaho, south at least to include the entire valley of the Snake River; part of western Wyoming; west to the Cascade Mountains in Oregon and Washington (occasionally west of the Cascade Mountains) exclusive of southern Lake, Harney, and Malheur counties in Oregon; south in northern California exclusive of coast district through Siskiyou and western Modoc and Lassen counties, thence west of the Sierra Nevada in central California as far as Fresno County; west to the Pacific Coast from southern Sonoma County to San Diego, California; limited to the coastal district south of Fresno County. There are records of the race occurring at Humboldt Bay, California (Townsend, 1887, p. 222), at Gray's Harbor, Washington (Lawrence, 1892, p. 46), and in the Chilliwack district (Brewster, 1893, p. 237) and on Vancouver Island (Fannin, 1891, p. 39), British Columbia.

Winter range: many, but not all, of the birds breeding in northeastern California, Oregon, Washington, Montana, Idaho, and British Columbia appear to migrate south into southeastern California, southern Arizona, western Mexico as far as Morelos, and casually also to southern Lower California. Some of the birds in the northern Sacramento Valley, California, apparently move south into the breeding range of *nevadensis* in the southern San Joaquin Valley. South of latitude 38° the race is entirely resident.

Comparisons.—For comparisons with *L. l. excubitorides, nevadensis, sonoriensis, grinnelli,* and *nelsoni* see pages 63, 76, 68, 71 and 73 respectively.

L. l. gambeli differs from *L. l. anthonyi* in postjuvenal plumages as follows: anterior part of forehead with more pallid neutral gray; white superciliary line more prominent; remainder of pileum, hind neck, back, and upper rump lighter, nearer neutral gray rather than deep neutral gray; outer scapulars with more white distally; lower rump and upper tail coverts lighter, pale neutral gray or white rather than light neutral gray; under parts without light neutral gray on flanks and breast; light mouse gray vermiculations extending to the flanks; wing length 2 to 5 per cent longer; amount of white on primaries 3 to 4 per cent greater; tail length 1 to 3 per cent greater; white tip on outer rectrix 10 per cent greater in adult males, similar in females; proximal outline of white tip on outer rectrix more irregular and varied; bill 4 to 5 per cent shorter; bill depth slightly less in adult males, similar in females; tarsometatarsal length and middle toe similar; hind toe 1 to 4 per cent longer.

L. l. gambeli differs from *L. l. mearnsi* as follows: anterior part of forehead with slightly more pallid neutral gray; remainder of pileum, hind neck, back, and upper rump nearer neutral gray rather than between dark neutral gray and deep mouse gray; lower rump and upper tail coverts averaging slightly darker; under parts slightly darker with more drab gray and more vermiculations; wing 2 per cent longer (averages available for adult males only in *mearnsi*); amount of white on primaries 4 per cent greater; tail 2 per cent longer; white tip on outer rectrix 10 per cent greater; proximal outline of white tip on outer rectrix more irregular and variable; bill

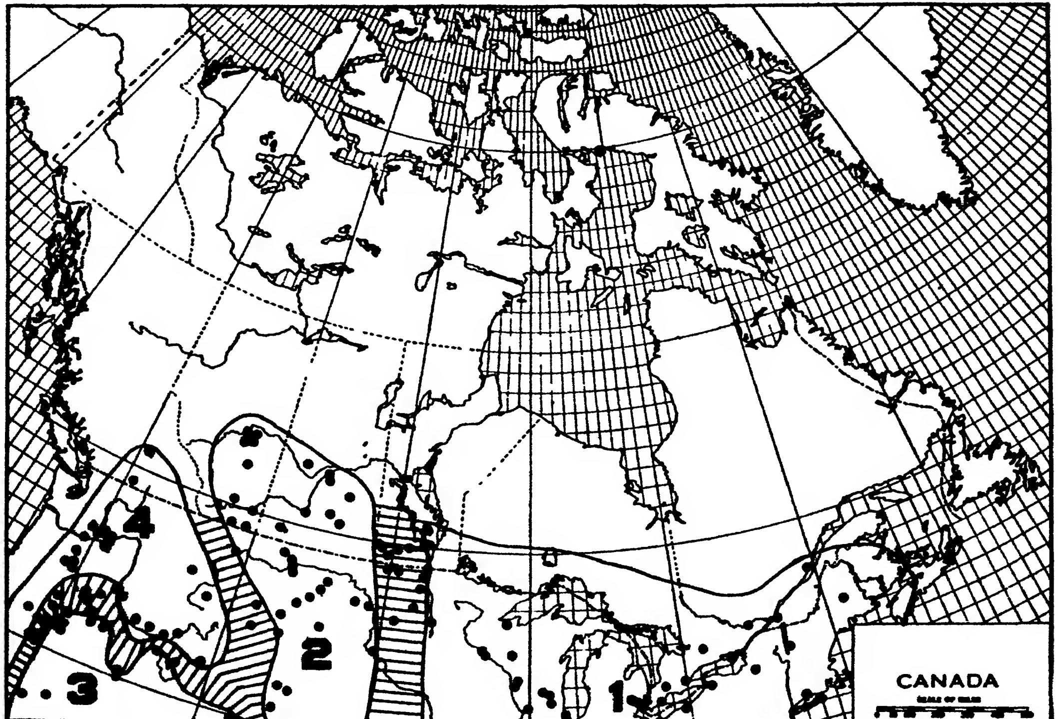

Fig. 18. Breeding ranges of Loggerhead Shrikes (*Lanius ludovicianus*) in Canada an the northern United States. 1, *L. l. migrans*; 2, *L. l. excubitorides*; 3, *L. l. nevadensis*; 4, *L. l. gambeli*. Dots indicate localities from which I have examined specimens. Zones of intergradation between races indicated by shading. See text for references to records of *gambeli* west of the range of this race as here shown.

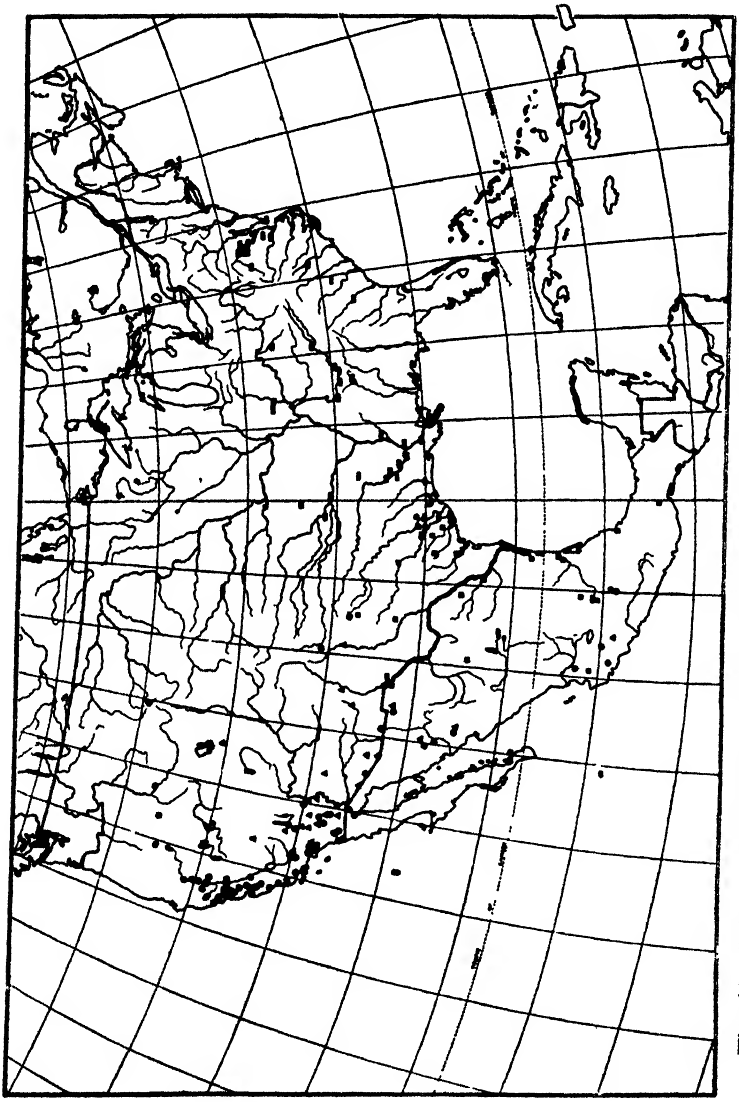

Fig. 19. Winter distribution in North America of the four races of Loggerhead Shrikes (*Lanius ludovicianus*) which are partly or entirely migratory. Rectangles = *L. l. migrans*; squares = *L. l. excubitorides*; triangles = *L. l. nevadensis*; dots = *L. l. gambeli*. Symbols indicate localities from which I have examined winter-taken specimens.

length 5 per cent greater; bill depth 2 per cent less; bill width 2 per cent less; feet similar, although hind toe is 2 per cent greater.

Remarks.—For mention of intergradation with *excubitorides, nevadensis, sonoriensis,* and *grinnelli* see pages 64, 76, 69, and 71 respectively.

Although *gambeli* cannot intergrade geographically with *anthonyi,* some specimens from the extreme coastal region of southern California adjacent to the Santa Barbara Islands show a partial resemblance to *anthonyi.* Contrary to the rather superficial observations of Dawson (1923, p. 600) it is not believed that shrikes regularly pass from the Santa Barbara Islands to the mainland or vice versa inasmuch as the island populations are extremely uniform and apparently receive no dilution as a result of invasions by *gambeli.* Furthermore, no specimens entirely typical of *anthonyi* are to be found in the extensive representation of birds from southern California. The similarity of some mainland birds to *anthonyi* is due, probably, to a set of environmental conditions along the mainland shores, which are similar to conditions on the island, and which operate upon island and mainland birds in like manner. Mainland birds thus modified by these conditions fail to establish a colony of *anthonyi*-like individuals because they are not isolated from the large inland population. The possible rare or occasional passage of *anthonyi* to the mainland could not account for the repeated occurrence of intermediates along the beaches of southern California.

The possible occurrence of *gambeli* in southern Lower California has already been discussed. The only specimen of shrike from Guadalupe Island, first reported as *Lanius ludovicianus excubitorides* by W. E. Bryant (1887, p. 306) and later recorded as *gambeli* by the same author (1889, p. 307), was lost in the San Francisco fire. No shrikes have been found on this island on subsequent visitations by ornithologists. Bryant also reports the taking of *gambeli* on the Farallon Islands, California (1888, p. 48).

Mearnsi does not intergrade structurally with *gambeli* and never is to be confused with any mainland form.

Lanius ludovicianus anthonyi Mearns

Collyrio excubitoroides, Cooper (1870, p. 78), part.
Collurio ludovicianus, Henshaw (1876, p. 237), part.
Lanius ludovicianus excubitorides, Blake (1887, p. 330), part.
Lanius ludovicianus gambeli, Grinnell (1898, p. 235), part.
Lanius ludovicianus anthonyi Mearns (1898, p. 261), original description, part.
Lanius anthonyi, Grinnell (1902, p. 62), part.
Lanius ludovicianus, Ogilvie-Grant (1902, p. 461), part.

Type.—Female first-year, no. 163074, U. S. Nat. Mus.; western end of Santa Cruz Island, California; May 6, 1897; collected by R. H. Beck; orig. no. 131.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Upper parts: pallid neutral gray of forehead limited to margin of black facial mask; remainder of pileum, hind neck, back, and upper rump deep neutral gray; lower rump and upper tail coverts light neutral gray; outer scapulars pallid neutral gray either narrowly margined with white or entirely lacking white as in *grinnelli*. Under parts: chin, throat, and malar region white; flanks, sides, breast, and coverts of tibiotarsus light neutral gray; center of breast and upper belly pale drab gray distinctly vermiculated with irregular bands of light mouse gray. Wings: either seventh or eighth primary longest; length, 96.40 mm.; white on primaries, 53.7 per cent of wing length. Tail: outer web of outermost rectrix partially or entirely white; length, 98.70 mm.; white tip on outermost rectrix, 26.9 per cent of tail length; ratio of wing to tail, 0.968:1. Bill: large, deep basally; hook long and acutely curved; length, 12.35 mm.; depth, 8.57 mm.; width, 6.14 mm. Feet: tarsometatarsal length, 27.29 mm.; middle toe, 13.56 mm.; hind toe, 9.87 mm.

Females, adult, breeding plumage.—Under parts similar to males but averaging darker gray and more heavily vermiculated. Wings: 95.75 mm.; white on primaries, 53.5 per cent of wing length. Tail: length, 98.70 mm.; white tip on outer rectrix, 29.2 per cent of tail length. Bill: length, 12.08 mm.; depth, 8.20 mm.; width, 6.21 mm. Feet: tarsometatarsal length, 27.20 mm.; middle toe, 13.06 mm.; hind toe, 9.56 mm.

Males, first-year, breeding plumage.—Coloration same as adult males in breeding plumage. Measurements not available in sufficient number to compile averages. Dimensions throughout probably slightly smaller than adults.

Males, first-year, fall plumage.—Coloration similar to first-year males in breeding plumage except during fall molt when colors of under parts are browner, that is, more drab gray, usually with more pronounced vermiculations.

Females, first-year, breeding plumage.—Wings: length, group A, 91.70 mm.; white on primaries, group A, 54.2 per cent of wing length. Tail: length, group A, 94.38 mm.; white tip on outer rectrix, group A, 28.2 per cent of tail length. Bill: length, group A, 11.82 mm.; depth, group A, 8.22 mm.; width, group A, 6.06 mm. Feet: tarsometatarsal length, group A, 27.18 mm.; middle toe, group A, 13.30 mm.; hind toe, group A, 9.78 mm.

Females, first-year, fall plumage.—Similar to first-year females in breeding plumage except during fall molt when colors of under parts browner and vermiculations more prominent.

Juveniles.—Coloration of upper parts similar, though darker, than in *L. l. ludovicianus*, near dark olive gray on back; breast, flanks, and upper belly near light drab, heavily and extensively vermiculated.

Distribution.—Permanent resident of Santa Cruz, Anacapa, Santa Rosa (small juvenal specimen, no. 137893, Biol. Surv.), and Santa Catalina islands, California.

Cooper's mention of a shrike on Santa Barbara Island (1870, p. 78) during May and June possibly refers to Santa Cruz Island and not to Santa Barbara Island as now known. No shrikes have

been found on Santa Barbara Island by any other ornithological expeditions.

Comparisons.—For comparisons with *gambeli* see page 79.

L. l. anthonyi differs from *L. l. mearnsi* in postjuvenal plumages as follows: coloration of pileum, hind neck, back, and upper rump slightly lighter, deep neutral gray rather than near dark neutral gray or dark mouse gray as in *mearnsi;* scapulars with less white; lower rump and upper tail coverts darker, never white or extremely light gray; breast and flanks darker, never white or pallid neutral gray; wings and tail similar, although perhaps slightly smaller; bill 9 per cent longer in adult males, relatively more slender basally; hook longer; tarsometatarsus slightly shorter.

Remarks.—Although *anthonyi* does not intergrade with *grinnelli,* the similarity in coloration of the two warrants mention of characters which separate the two races. *Grinnelli* is more extensively light neutral gray below, this color extending entirely across the breast and on to the lower throat; the rump of *grinnelli* is lighter than that of *anthonyi.* Most striking, however, are size differences in length of wing and tail, *anthonyi* being 5 to 6 per cent smaller in these dimensions, no intergradation in length of wing existing between the two.

Some specimens from Santa Catalina Island, although referable to *anthonyi,* may be considered as structural intergrades in the direction of *mearnsi.* These specimens may possess a nearly white rump, and a bill intermediate in length between the two subspecies; their coloration, aside from the rump, is that of *anthonyi.*

For mention of intergradation with *gambeli* see page 82.

Lanius ludovicianus mearnsi Ridgway

Lanius ludovicianus gambeli, Grinnell (1897, p. 19), part.

Lanius ludovicianus anthonyi Mearns (1898, p. 261), part.

Lanius ludovicianus mearnsi Ridgway (1903, p. 108), original description, part.

Lanius anthonyi, Grinnell (1902, p. 62), part.

Lanius mearnsi, Linton (1908*a*, p. 85).

Type.—Female immature in postjuvenal molt, no. 134781 U. S. Nat. Mus.; Smuggler's Cove, San Clemente Island, California; August 27, 1894; collected by E. A. Mearns, orig. no. 11368.

Diagnosis.—Descriptions of corresponding plumages of *L. l. ludovicianus* apply to this form unless otherwise specified.

Males, adult, breeding plumage.—Pallid neutral gray of forehead limited to margin of black facial mask; remainder of pileum, hind neck, back, and upper rump between dark neutral gray and dark mouse gray, the basal parts of feathers often black similar to *mexicanus;* outer scapulars margined with white; rump and upper tail coverts white, rarely pallid neutral gray or white. Under parts: breast and flanks either white or faintly tinged with pallid neutral gray and occasionally faintly vermiculated; sides and coverts of tibiotarsus either pallid or pale neutral gray. Wings: length, 97.64 mm.; white on primaries, 53.8 per cent of wing length. Tail: length,

100.28 mm.; white tip on outer rectrix, 28.1 per cent of tail length. Bill: short, thick basally; hook short and moderately curved; length, 11.40 mm.; depth, 8.52 mm.; width, 6.26 mm. Feet: tarsometatarsal length, 27.60 mm.; middle toe, 13.20 mm.; hind toe, 9.92 mm.

Females, adult, breeding plumage.—Coloration similar to adult males although slightly darker dorsally. Dimensions probably smaller, averages not available.

First-year plumages in so far as known similar to adults with no marked age variation.

Juveniles.—Coloration of upper parts near dark olive gray, darker than in *L. l. ludovicianus.* Breast and flanks smoke gray with abundant, fine vermiculations.

Distribution.—Permanent resident of San Clemente Island, California.

Comparisons.—For comparisons with *nelsoni, gambeli,* and *anthonyi* see pages 73, 79, and 84 respectively.

Mearnsi, although not intergrading with *grinnelli* of the mainland slightly to the southward, may be distinguished from this form by the decidedly lighter color of the under parts, much smaller wing and tail, and much shorter bill.

Remarks.—The only race with which *mearnsi* intergrades is *anthonyi* to the northward (see p. 84). No intergradation with *gambeli* is indicated in any of the specimens from the coast of southern California. Of all the subspecies of *L. ludovicianus, mearnsi* is the most isolated race and is among the most sharply characterized subspecies of the species. Although not to be considered as a distinct species, it is surprising to note the doubts that ornithologists have entertained concerning the validity of this race (A. O. U. Check-list, 1910, p. 297).

OLD WORLD SPECIES ERRONEOUSLY ATTRIBUTED TO NORTH AMERICA

Lanius excubitor algeriensis Lesson

Under the name *Collurio ludovicianus* var. *robustus,* Baird, in an article by Ridgway (1873, p. 608), described as new, a specimen of *algeriensis* supposedly from California. This specimen was later reported by Ridgway (1897, p. 323) as being identical with *Lanius algeriensis* of Africa. J. Grinnell has recently examined the type of *robustus,* no. 15303, Acad. Nat. Sci. Phila., and reports that it is certainly referable to *algeriensis.* He further reports that the specimen is one which was formerly mounted. This fact tends to confirm the opinion which has been prevalent for a number of years that this specimen which Gambel marked as from California was probably not taken in California, but was secured through some taxidermist and, more than likely, was obtained originally from within the normal range of *algeriensis.*

Lanius excubitor elegans Swainson

This form was described from a specimen now in the British Museum, supposedly taken in the "fur countries" of North America and accordingly attributed to the New World. The specimen was considered to be identical with *Lanius lahtora* Sykes by Sharp and Dresser (1870, p. 595) but later, according to Schiebel (1906, p. 71) and Hartert (1914, p. 427), has proved to be identical with *Lanius hemileucurus* described by Finsch and Hartlaub (1870, p. 329) from northern Africa, which name *elegans* antedates. It is extremely doubtful whether the type of *elegans* actually was taken in North America. Therefore, this subspecies of *L. excubitor* cannot be considered as occurring in the New World, no other American specimens ever having been taken.

Lanius excubitor mollis Eversmann

To my knowledge there is only one doubtful record of the eastern Siberian form of *L. excubitor* occurring in North America. Schalow (1884, pp. 292, 293) records a specimen from the Chilkat River, Alaska, under the name *Lanius major* Pallas. The shrikes of the *Lanius excubitor* group were poorly understood at the time of the publication of this record and it is probable that the specimen belonged to *invictus* or else was an intergrade approaching *mollis*.

The record of *mollis* at sea off the coast of Alaska by Mailliard and Hanna (1921, p. 93) was later corrected by Swarth (1927, p. 205), the specimen proving to be an immature *invictus*. I have seen this specimen, no. 23498, Calif. Acad. Sci., and entirely agree with Swarth's conclusion.

GEOGRAPHIC VARIATION

The species *Lanius ludovicianus* affords opportunity to compare geographic variation in structure with differences in the environment encountered in the ranges of the various subspecies. For the most part the environmental differences which will be discussed are those pertaining to physiographical and floral features of the shrike habitats. I have little doubt that significant differences in behavior, mannerisms, animal associates, and food preferences could be found between some of the races of the Loggerhead Shrike if a single observer had facilities to make exhaustive field studies of all the races. The information on these latter subjects gained from perusing the literature is abundant yet always cursory and so involved with the varying qualifications of observers as to be of slight value in making exact comparisons.

For example, the description of the habits of the African species, *Lanius mackinnoni* by Bates (1930, p. 425) is a good average type of a composite observation record. Part of Bates' account of *mackinnoni* is as follows:

> It is a bird of farms where it perches on bare exposed limbs over cultivated ground so that it can pounce down on grasshoppers or other insects or small frogs; it flies back to its perch to eat its catch. Once only did I find the body of a partly eaten young bird sticking to a thorn, showing that this Shrike also is a "Butcher Bird." Though I have never seen it catch other birds (it is not a large Shrike), it always flies at and drives away other birds that light on its feeding ground. It seems a little incongruous to find this truculent bird a sweet singer, but it is so. It does not pour forth its song at dawn of day, but trickles it out a few low, sweet notes at a time while on its perch at midday; its song includes good imitations of the songs of other birds.

To those familiar with the Loggerhead Shrike in North America it will be apparent that all the above statements might apply to the American species. Either the habits of shrikes of the genus *Lanius* are extremely uniform or else the usual type of observation is limited to the general features of behavior, the small differences between species and subspecies being overlooked. I am inclined to believe that the latter to a large extent is true, although there certainly is considerable uniformity of behavior within the genus.

Before considering geographic variation, a brief description of the summer habitat of each race of *L. ludovicianus* proves necessary.

L. l. ludovicianus.—A. H. Howell states (1924, p. 270) that in Alabama this shrike "is a fairly common resident from the coast to the northern limit of the Central Prairie Belt. It is of local distribution and is most abundant in the prairie region; a bird chiefly of the farming country." The prairie region, according to Howell (1921, p. 8), consists of rolling plains but includes many small areas of forested land (*Quercus durandi, Quercus minor, Pinus taeda, Pinus palustris,* and others), and extensive wooded swamps. At the northern limit of the range of *L. l. ludovicianus* at Ashland, Virginia, Embody (1901, p. 169) describes the terrane in which shrikes occur as oak and pine woods with occasional swamps. Bent and Copeland (1927, p. 384) describe the Loggerhead Shrike as "about next to the commonest bird in Florida. It is a resident everywhere along the road sides, sitting on poles and wires, and also found commonly in the flat pine woods." In Louisiana Kopman (1915, p. 184) states that *L. l. ludovicianus* is a resident of the "pineries" and other dry locations in the state.

Summarizing from a large number of statements, of which the foregoing are representative, it may be seen that *L. l. ludovicianus*, although seeking open fields and clearings as do all members of the species, nevertheless frequents territory which for a Loggerhead Shrike is on the average relatively well wooded. The distances between trees and bushes wherein the perches are located are perhaps on the average slightly shorter and the vegetation somewhat denser than in the habitats occupied by many of the races of this species. Probably considerable time is spent in hunting in open thickets, tall weeds, and rushes. The life-zone occupied is chiefly Austroriparian with some Carolinian at the northern and western limits of the range. The rainfall and humidity are high, most of the precipitation falling during the spring and summer. For further details concerning the climate table 11 has been prepared; it indicates in a gross way the conditions prevailing in the ranges of some of the races of *L. ludovicianus*.

L. l. migrans.—In the wooded portions of the range of *migrans*, the shrikes are limited to clearings, meadows, and pastures. In Indiana, Butler (1897, p. 1007) speaks of this form as frequenting "the more level land nesting in hedges and thorn trees. As the woods are cleared and hedges planted these birds are invading new territory." This statement is typical of the northern and eastern parts of the range of this subspecies. Linsdale (1928*a*, p. 586) says of the Migrant Shrike in eastern Kansas, "usually found in Osage Orange or in other thickets along the roads." The forested lands included within the habitat of *migrans* are composed largely of broadleaf trees. As nearly as can be ascertained it does not often frequent pine lands. as does *L. l. ludovicianus*. The humidity and rainfall are less than in the habitat of *L. l. ludovicianus* although considerable variation is encountered in the large territory occupied by this race. The life-zones occupied are Alleghanian and Carolinian, locally Canadian.

L. l. excubitorides.—This race is found chiefly in arid, short grass or desert savanna, plains areas. In these regions the original terrane is rarely modified by small farms. In the north the range of this race includes some areas of more luxuriant grassland. The birds forage out over the plains but usually they are to be found near the timber, principally cottonwoods, along water courses. Ferry (1910, p. 185) describes the country around Prince Albert, Saskatchewan, as rolling plains with ponds and poplar thickets. A nest of shrikes was found by him in a small bunch of willows at the edge of a swamp. In

Harding County, South Dakota, Visher (1911, p. 15) speaks of *excubitorides* as an "abundant summer resident of the plains. Nests in the scattered trees which occur along the intermittent creeks." In Texas the race is found irregularly in regions where scattered oaks and mesquites occur. Throughout its summer habitat *excubitorides* encounters comparatively arid conditions with the exception of some northern parts of its range in Canada. Life-zones occupied are Upper and Lower Sonoran, locally Transition in the north.

TABLE 11

Estimated Climatic Conditions Prevailing in the Habitats of Some of the Races of *Lanius ludovicianus*

	L. l. ludovicianus	migrans	excubitorides	sonoriensis	grinnelli	nevadensis	gambeli	anthonyi	mearnsi
Annual precipitation	40–60	30–50	10–30	0–15	0–20	0–15	10–50	Probably 20–30	Probably 15–25
Time of year during which majority of precipitation takes place	March-September	March-November	April-September	July-October	Probably December-February	November-March	December-February	December-February	December-February
Average relative humidity at 2 p.m. in July	50–65	45–60	25–50	Up to 35	Up to 50	Up to 35	25–50	40–50	Probably 30–40
Total annual number of days with dense fog	0–20	0–30	0–10	0–5	Probably up to 40	0–5	5–40	30–40	20–30
Average number of days (non-consecutive) with snow on the ground	0 10	winter range 1–30	winter range 1–30	0–1	0	winter range 1–30	winter range 1–30	0	0
Average annual number of clear days	120–160	80–160	140–200	200–300	?	160–300	120–220	?	?

Statistics based on Kincer (1922), section on precipitation and rainfall in the atlas of American agriculture.

L. l. mexicanus.—Few descriptions of the habitat of this race are to be found. Most of the accounts of shrikes in southern and central Mexico are complicated by reason of confusion of resident and winter visitant birds. Principal among the regions inhabited by *mexicanus* is the central plateau area containing a flora characterized by Nelson (1926, fig. 13, opposite p. 577) as scrub—chiefly mesquite, yucca, and agave cactus. He names (p. 582) the scrub area of the plateau the Covillea association and classes it as Lower Austral. *Mexicanus* is encountered locally in pine and deciduous forest areas, and the Piñon-

Juniper association of the Upper Austral probably also is entered by shrikes of this race. Cox (1895, p. 358) mentions taking a shrike at the lower limit of the pine timber on Orizaba Peak, Puebla, in summer. He records the specimen as *excubitorides* although it doubtless belonged to *mexicanus* in view of the time and place of collection. Quoting again from Nelson (p. 576) the climate of Mexico "is humid in the southern portion, the precipitation decreasing rapidly toward the north, especially in the tableland region where it slopes down to the lower Rio Grande." The latter statement is particularly significant as the southern border of the drainage basin of the lower Rio Grande coincides with the northern limit of the range of *mexicanus.*

L. l. sonoriensis.—Mearns (1907, pp. 108, 109) describes the vicinity of Tucson, Arizona, where numerous specimens of *sonoriensis* have been taken as follows:

> The streams—Rillito Creek and the Santa Cruz River—are well wooded with screw bean, mesquite, cottonwood, willow, boxelder, and ash, groups of which are often converted into fragrant bowers by climbing grape and *Philibertella* with spring asters, showy daturas, and many flowering plants beneath and around them. The foothills of the Tucson and Santa Catalina mountains are sprinkled with giant cactus. Mesquites begin as shrubs no larger than the mimosa and acacia on the sandy mesa, but increase to the dimensions of New England apple trees, the mesquite groves of the Rillito having a decidedly orchard-like appearance.

Swarth (1905, p. 80), however, mentions *sonoriensis* in apparently more barren surroundings near the Santa Rita Mountains, Arizona. "On June 21 I found a nest with five eggs in a scraggly little mesquite bush perfectly unsheltered and unhidden. The birds sat on the bush within arm's reach, with mouths open suffering with the heat too much to care what happened." In the Coachella Valley of California I have encountered shrikes scattered through the clumps of mesquite, desert willow, palo verde, and smoke-bush growing in the dry sandy water courses. Two nests have been found by me in open groves of mesquite and catsclaw. Near Yuma, Arizona, and at other points along the Colorado River, shrikes of this race are found inhabiting the cotton fields. Throughout the range of *sonoriensis* extreme aridity prevails. The entire range of the race is included in the Lower Sonoran life-zone.

L. l. grinnelli.—The San Pedro Mártir section of Lower California of which this race is characteristic has been termed by Grinnell (1928, p. 16) a "humid desert; that is to say, there exists a region of meager rainfall but of high atmospheric humidity. Fog or cloudiness is frequent over an intensely dry terrane!" Anthony (1895, p. 134) in

speaking of San Fernando, Lower California, the type locality of *grinnelli*, mentions mesquite and catsclaw bushes near the mission but states that the surrounding country is a dry mesa with barren arroyos and had been without rain for three years at the time of his explorations in the region. Shrikes were seen only at the mission, he reports. At Valle Trinidad where several specimens of typical *grinnelli* have been taken, Lamb (MS) described the valley as a sort of meadow (dry) with a shallow stream and scattered mesquites; bordering the valley are regions of mesquites, arrowweed, and cactus; the soil is very sandy.

Fig. 20. San Fernando Mission, Lower California, type locality of *L. l. grinnelli*. Photograph taken in June, 1927. Mus. Vert. Zool. no. 5369.

L. l. nelsoni.--The range of *nelsoni* includes considerable variety of faunal habitats in both the Arid Tropical and Lower Sonoran life-zones. Bancroft (1930, p. 42) states the habitat preferences of this shrike in the northern part of its range as follows:

> There are shrikes at Santa Rosalia. In any small cañon which runs back from the Gulf and which also contains a few trees, three or four, perhaps a breeding pair, of these birds are apt to be found. They nest near San Ignacio Lagoon and among the sand dunes along with the Desert Thrasher. They occupy intermittently the terrain between these extremes but only in associations of low brush or of isolated trees. On the whole they are to be listed as rare birds.

Todos Santos, the type locality, is not so barren as the country described by Bancroft. Nelson (1921, pp. 44, 45, figs. 1, 2) states that the town of Todos Santos is located on a low bare ridge overlooking a valley with palms and fields of sugar cane. Outside of the settlement the country is more arid although in places in the foothills a low jungle of Arid Tropical and Lower Sonoran vegetation exists. Little

rain falls within the range of *nelsoni*, many regions lacking any precipitation for periods of several years. The fog belt along the Pacific Coast in the northern part of Lower California does not extend south of the Cedros Islands, the northern limit of the range of *nelsoni*.

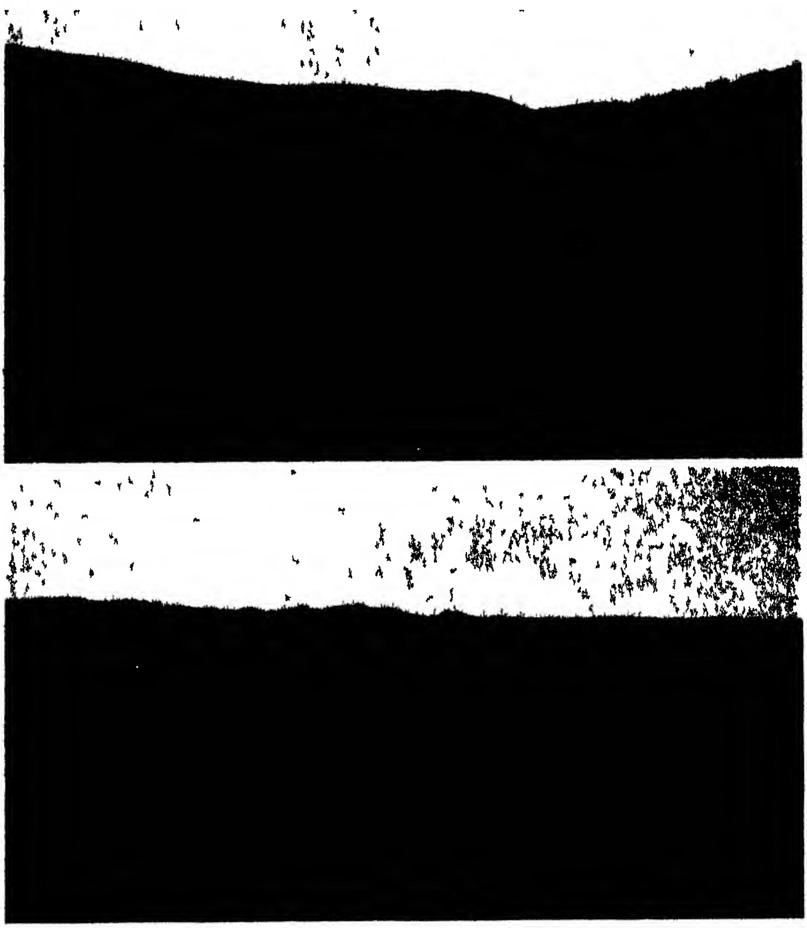

Fig. 21. Upper, dry arroyo near San Telmo, Lower California. Breeding habitat of *L. l. grinnelli*. Photograph taken April 6, 1925. Mus. Vert. Zool. no. 4802.

Lower, Valle de la Trinidad, Lower California. Breeding habitat of *L. l. grinnelli*. Photograph taken December 15, 1926. Mus. Vert. Zool. no. 5341.

L. l. nevadensis.—In the summer of 1929, I encountered this race in the extreme southern San Joaquin Valley and on the Mohave Desert, California. Shrikes were found wherever bushes, usually *Artemisia tridentata* or *Atriplex*, two feet or more in height, occurred. Southeast of Buena Vista Lake shrikes were found with LeConte

Thrashers in small mesquites situated on the crests of sand dunes. Where cultivation had brought a stand of broadleaf trees, a pair or family group of shrikes was always resident. In the Joshua tree areas of the Mohave Desert the race was always seen but never in abundance. Over a large part of Nevada and the Owens Valley in California the principal habitat is in the Artemisia association combined with willows or cottonwoods wherever these are present. Most of the range of this race is characterized by comparative drought during the summer season although conditions are not always so intensely arid as in the range of *sonoriensis*.

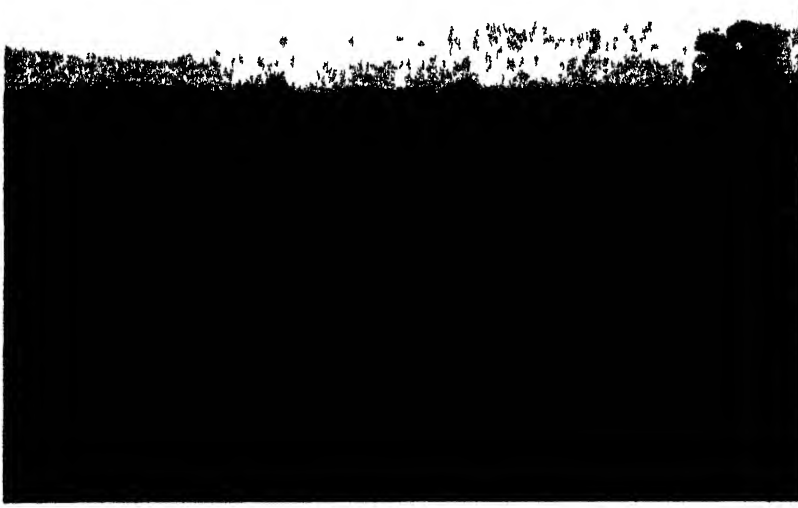

Fig. 22. Joshua trees and creosote bushes on flat near Mohave, Kern County, California. Breeding habitat of *L. l. nevadensis*. Photograph taken September 14, 1911. Mus. Vert. Zool. no. 619.

L. l. gambeli.—The habitat of *gambeli* is varied to an extreme. In the north in the valley of the Deschutes River or along the John Day River in Oregon, this race is found in Artemisia and Juniper habitats but also in scattered broadleaf timber and in the meadows and grasslands along the river courses. The Artemisia habitat is essentially the same as that occupied by *nevadensis* to the southward but is generally more humid. *Gambeli* follows the Artemisia belt into Idaho, western Wyoming, and eastern Washington. In northeastern California again it is found in Artemisia and Juniper. Throughout central and southern California much of its range has been highly modified by cultivation. Here it is resident principally about irrigated lands

and orchards in the Sacramento-San Joaquin Valley. It is not found in densely timbered areas other than at the margins of broadleaf timber along the rivers. It is absent in the Chaparral habitat but present in oak timber where the trees are far apart and where they are located on open rolling hills or on level land. Much of the range of *gambeli* is moderately arid but the coastal portions in California experience frequent fogs.

L. l. anthonyi.—The islands of Santa Catalina and Santa Cruz off the coast of southern California comprise most of the range of this subspecies. Santa Rosa Island may possess a considerable population but thus far few records for this island have appeared. Parts of Santa Cruz Island are forested with live oaks and the Monterey pine. In August, 1922, I found shrikes in the pines and acacias at Prisoner's Harbor and also in the scattered live oaks in the cañon leading from this point toward the interior of the island. Much of the habitat, however, consists of grasslands with small bushes in the cañons. The hills and cañons which the shrikes frequent are often exceedingly precipitous. Likewise, on Santa Catalina Island much of the habitat consists of steep hillsides covered with scrub oak, toyon, ironwood, and, in places, dense stands of opuntia cactus. Detailed information concerning weather conditions on these islands is not available. The precipitation is not great, probably corresponding to the adjacent parts of the mainland coast. Fogs are frequent, however, and blanket the islands for considerable periods. Extensive growth of *Mesembryanthemum* as well as the pines on Santa Cruz are probably maintained largely because of the frequent fogs.

L. l. mearnsi.—San Clemente Island is more arid than those islands of the Santa Barbara group on which *anthonyi* occurs. Howell (1917, p. 10) says that "at the southeast end, at Mosquito Harbor, there is water and a number of trees, but the northwest part is devoid of moisture for the greater part of the year and there are no trees and very little brush. Back from the coast the land is rolling." Grinnell (1897, p. 12) states that

> the vegetation on this island is not superabundant. It is mainly composed of cactus of several species and a few low thorny bushes on the mesas and hill sides; while the cañons and ravines usually contain thickets of wild cherry bushes which in places reach a height of fifteen feet or more, and might be called trees. . . . . The northeastern side of the island is steep rising abruptly to the summit ridge . . . . From this ridge the land slopes gradually through a series of parallel benches or mesas to the southwest coast. Cutting their way westward transversely through these mesas from the summit ridge, are numerous ravines and cañons. Some of the latter are very deep and narrow.

Later (p. 20) mention is made of a nest of shrikes "in a small bush growing out from the side of the cañon." Although arid, San Clemente is subject to the ocean fogs common in this region.

Correlations between environments and subspecific characters have been sought chiefly as regards the summer ranges of the shrike population. Whether the correlations between environment and structure have been produced indirectly through the orthodox genetic mechanisms or through some more immediate effect of the environment upon the soma of the individual, in either case the breeding

Fig. 23. Hills near Avalon, Santa Catalina Island, California. Breeding habitat of *L. l. anthonyi*. Photograph taken April 10, 1920. Mus. Vert. Zool. no. 3350.

season may be considered the most critical period of the year. At this time, in birds, the maturation of germ cells, development of young, and the principal molt take place. Nevertheless, it may be argued, that the variations finding their first manifestation during the breeding season are subjected to a more rigorous natural selection during the winter, thus laying emphasis upon the winter habitat. For the most part, ecological studies have not reached sufficient refinement to permit of observing directly in the field the selective value of subspecific characters of birds. In the Imperial Valley of California *gambeli* and *sonoriensis* occupy the same winter habitat. If selection during the winter is to favor one type of shrike as more successful or more fit from out of this mixed winter population, why is it that both races persist? Like cases may be pointed out in *excubitorides* and

mexicanus, and in *L. l. ludovicianus* and *migrans*, whose winter ranges partly coincide. The geographic races of shrikes conform, then, to differences in summer habitat. The winter habitats would appear to be of little importance in the differentiation of a subspecies of shrike; whatever link exists between structure and environment applies to the breeding habitat in the case of the migratory races of these shrikes.

Compared with some species of birds such as Horned Larks or Bewick Wrens, individual Loggerhead Shrikes of any one race appear to me on the average to possess a greater latitude of habitat preference. The individuals are comparatively wide-ranging and few extensive or effective barriers limit their wanderings. Consequently, most races occupy large areas. Races of Loggerhead Shrikes have not differentiated to correspond to each local set of environmental conditions for the reason that they are not isolated in, or restricted to, such limited or local conditions. Assuming that a shrike influenced by conditions operating over a small area only, became modified accordingly, it still would fail to establish a recognizable geographic race. This would be true, in the first place, because there would be few other shrikes similarly modified with which this particular bird might mate; secondly, there are usually no effective barriers to prevent such a modified bird from wandering outside of its local sphere of environmental conditions either in search of food or mate, and thus becoming amalgamated with the surrounding unaffected population. In other words, a shrike population is too scattered, consequently, at times, wide ranging, and also too tolerant of varying conditions to produce a large number of local geographic races. In the case of *L. ludovicianus*, the seeking of correlations between subspecific characters and wide-spread climatic and associational conditions may be justified on these grounds.

For convenience, geographic variation in color, including some features previously listed under markings, can be grouped into five divisions; each of these groups of characters may vary independently of the other groups. Within each group, variations in the different plumage areas included appear to be closely correlated. These five divisions are: color of the upper parts, exclusive of the scapulars and rump, and including the back, head, margin of facial mask, superciliary line, and the posterior development of the facial mask; the under parts, exclusive of the vermiculations; the lower rump and upper tail coverts; the scapulars; and, the vermiculations of the under parts.

It is safe to say that the characters grouped as dorsal coloration are associated with rainfall and humidity. A perfect correlation does not exist throughout the species, but within each group of adjacent and seemingly closely related subspecies the darkest dorsal coloration is found to occur in the more humid geographic areas. Thus, in the group of subspecies comprising *L. l. ludovicianus*, *migrans*, and *excubitorides*, the three races in the order named occupy on the average progressively more arid climates and, correspondingly, are progressively lighter dorsally. Whether this correlation is due to the direct influence of climate on the race or has been brought about through some principle of selection and adaptive coloration I have not been able to determine. Similar correlation is seen in groups composed of *mexicanus*, *grinnelli*, and *sonoriensis*, and in *anthonyi*, *gambeli*, *nelsoni*, and *nevadensis*. *Mearnsi* might be expected to be lighter dorsally than *anthonyi* whereas actually it is slightly darker. The difference here is not great, however, and might be attributed to isolation of the *mearnsi* stock which perhaps formerly inhabited a more humid mainland or island than the present habitat on San Clemente Island.

The color of the under parts is but roughly correlated with known climatic variables. Tentatively, however, it would appear that birds inhabiting foggy or cloudy regions have under parts other than white. *Gambeli*, *migrans*, *anthonyi*, and *grinnelli* fall in this category. *Mexicanus* and *L. l. ludovicianus*, although dark-colored dorsally, in adults, are white beneath and are both subjected to relatively humid climate but the precipitation within their habitats is usually not accompanied by long periods of cloudy or foggy weather. *Nelsoni* and again *mearnsi* are difficult to fit into such a correlation, for *nelsoni* is approximately as dark beneath as its close relative *gambeli*, whereas *mearnsi* is unaccountably light compared with the forms of the adjacent mainland. However, if *nelsoni* be compared with *grinnelli* immediately to the north and *mearnsi* be compared with its nearest relative *anthonyi*, the correlation of overcast weather with darker under parts appears to hold true.

In connection with the coloration of both dorsal and ventral surfaces the suggestion has arisen that the forms at the periphery of the species are dark-colored and represent a more primitive condition. This possibly might be true for *mexicanus*, *mearnsi*, *anthonyi*, and *L. l. ludovicianus* but it is difficult to explain the dark-colored *grinnelli* in this way. Furthermore, the moderately light-colored *nelsoni* at the extremity of the Lower California peninsula cannot be considered as

a possible remnant of a dark-colored ancestral stock. The only boundary of the species where an extremely light-colored form occurs is in central Canada, but this is also the only boundary of the species which is far removed from the humid areas usually associated with coastal or tropical regions and usually productive of dark-colored forms. Again, it might be argued that a new or later light-colored stock of the *excubitorides* type had invaded North America from the Old World via Western Canada. This argument may be countered by the fact that such invasion is unlikely by reason of lack of suitable Loggerhead Shrike environment in the north during the glacial period in the Pleistocene. If an invading light-colored stock had arrived in northern Canada previous to Pleistocene time, there is no seeming reason why it should not also, during the Pleistocene, have invaded the Gulf Coast and the highlands of Mexico before the Recent, since shrike populations in southern Canada today migrate south annually into the range of *mexicanus* and *L. l. ludovicianus;* either it did not thus invade the southern United States or else, since the time of such an invasion, it has become greatly modified and darkened.

The colors so far discussed, therefore, seem to be responsive, in general, to climatic conditions or the intermediary products of these conditions. The correspondence between the two might prove to be closer were the environments of the various subspecies better known.

The presence or absence of a white rump, variable as this feature appears to be, divides the species *L. ludovicianus* roughly into two groups. The two races along the Atlantic Coast distinctly lack a light-colored rump although some exceptions may be found in *migrans.* On the other hand, races west of the Mississippi River belong to a group with predominantly light-colored rumps. Such dark-colored races as *mexicanus, mearnsi,* and *grinnelli* still retain a white or light gray rump, this presumably being derived from some light-rumped ancestor. In some *gambeli* and in *anthonyi* the rump and back are practically or entirely concolor. Nevertheless, in view of the adjacent related light-rumped races, I consider the dark rumps in such forms a secondary condition arising concurrently with a widespread deepening of pigmentation in other parts of the plumage. In the western races, except for *grinnelli,* it might appear that the color of the rump is correlated with the color of the under parts, but this is distinctly not so in the two Atlantic Coast races. It will be seen, then, that the rump cannot be associated closely with such environmental variables as now are perceived. To a degree it has responded, as do the back

and head, to differences in humidity but appears to be more conservative in its response. I am unable to suggest utilitarian reasons for the existence or absence of a white rump area unless the character be assigned to those markings which serve as recognition marks to members of the species or to foreign species.

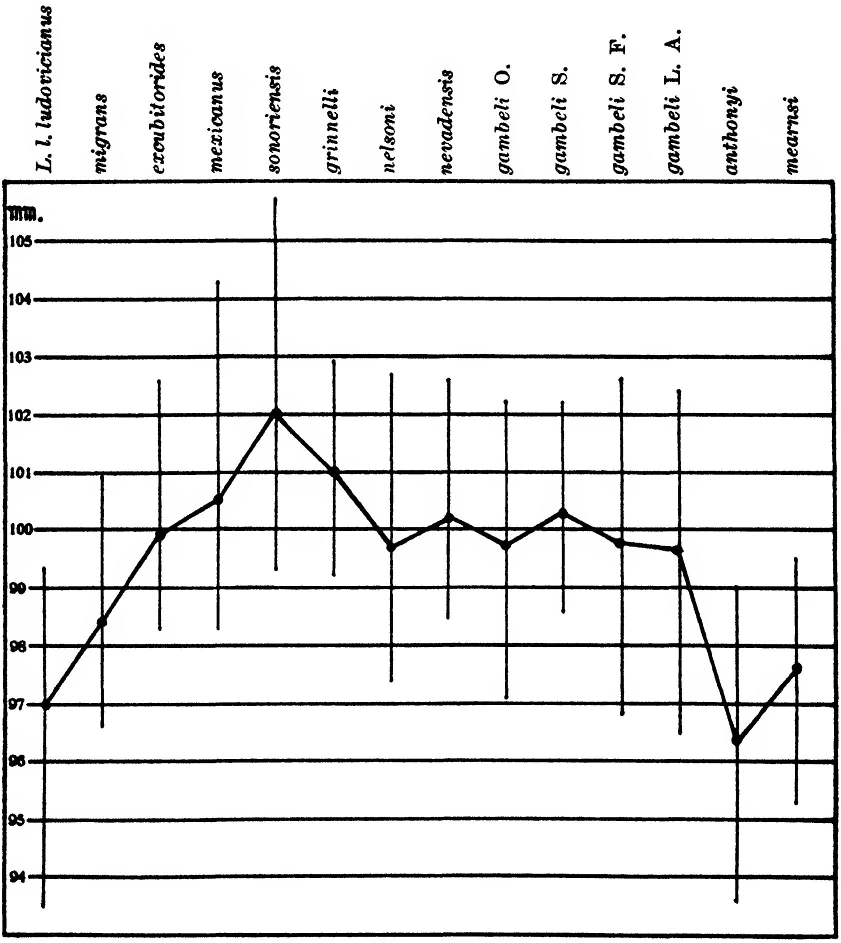

Fig. 24. Diagram showing individual and geographic variation in length of wing of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

The white of the scapulars varies but slightly in the several races, yet always seems to be correlated with changes in the color of the under parts, not with the variation of the rump. The latitude of the variation in color of the scapulars is not of the magnitude of that of the under parts. In *grinnelli,* the darkest beneath of all races, the scapulars are likewise the darkest of any race of the species. Similar

correlation is to be seen in *anthonyi, gambeli,* and *mexicanus,* as well as in the races with extremely light under parts, such as *excubitorides* and *sonoriensis.*

The presence of vermiculations on the under parts is somewhat dependent upon the general darkness of these areas. Nevertheless, vermiculations are far more frequent in the races occurring west of the continental divide. *Excubitorides, migrans,* and *ludovicianus* constitute a group largely free from vermiculations in postjuvenal plumages. *Nevadensis* and *mexicanus,* although light-colored beneath

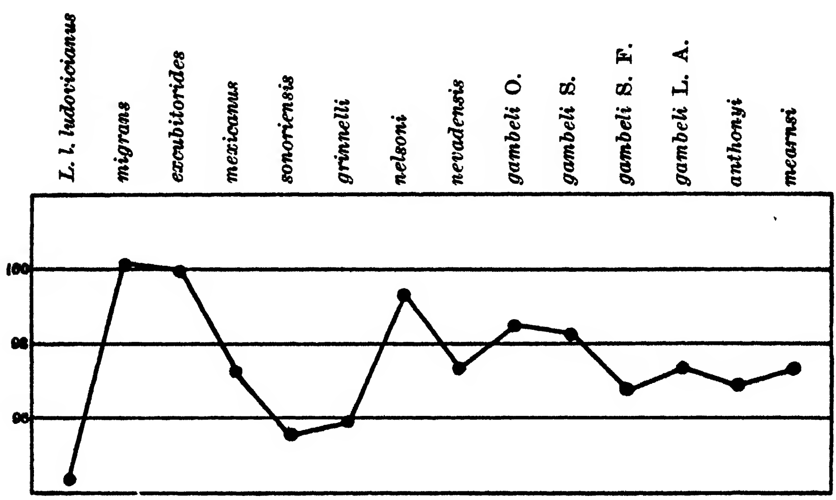

Fig. 25. Diagram showing geographic variations in ratio of wing length to tail length in fourteen geographic groups. Wing length is expressed in terms of per cent of tail length.

in adults, appear to show their relationship to the group with vermiculated breasts by the appearance of definite vermiculations in first-year birds. *Sonoriensis,* probably because of its extremely white under parts, possesses few vermiculations even in first-fall birds although its relationships with the western vermiculated forms seems to be close.

Variation in length of wing and tail has several factors to be considered as accounting for the differences among the races. Two types of variation are to be noted, the one, variation in ratio of wing length to tail length, and the second, variation in wing and tail length with the ratio between the two constant. Figure 25 illustrates a correlation between migration and the ratio of wing to tail, in this case the ratio being expressed as wing length in terms of per cent of tail length. Thus, *migrans* and *excubitorides,* both migratory races, show marked contrast to the resident *L. l. ludovicianus, sonoriensis,* and *mexicanus*

in the possession of relatively longer wings. The high position of *nelsoni* is possibly incorrect as only five adult males were usable. Within *gambeli* it will be seen that the migratory groups from the northern part of the range are higher on the diagram, that is, are relatively longer winged, than are the strictly resident populations

TABLE 12

GEOGRAPHIC VARIATION IN LENGTH OF WING
Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e. borealis	♂ adult	3	116.1	111.2	4.9	113.70		
e. borealis	♂ first-year	21	116.7	108.0	8.7	112.49±0.30	2.06±0.21	1.83±0.19
e. borealis	♀ adult	6	115.7	109.5	6.2	112.48		
e. borealis	♀ first-year	22	114.0	110.0	4.0	111.06±0.14	1.00±0.10	0.90±0.09
e. invictus	♂ adult	11	119.7	114.6	5.1	118.00±0.29	1.46±0.20	1.23±0.17
e. invictus	♂ first-year	30	119.5	111.2	8.3	115.75±0.23	1.88±0.16	1.62±0.14
e. invictus	♀ adult	4	116.8	109.2	7.6	113.00		
e. invictus	♀ first-year	31	117.7	111.9	5.8	114.88±0.17	1.45±0.12	1.26±0.10
l. ludovicianus	♂ adult	39	99.3	93.5	5.8	96.98±0.18	1.72±0.13	1.77±0.13
l. ludovicianus	♀ adult	31	96.0	90.0	6.0	93.89±0.20	1.69±0.14	1.79±0.15
l. migrans	♂ adult	18	100.9	96.6	4.3	98.42±0.21	1.53±0.17	1.55±0.17
l. migrans	♀ adult	16	100.7	94.3	6.4	97.83±0.30	1.82±0.21	1.86±0.22
l. excubitorides	♂ adult	12	102.6	98.3	4.3	99.92±0.23	1.23±0.16	1.23±0.16
l. excubitorides	♀ adult	7	100.8	98.0	2.8	98.92		
l. mexicanus	♂ adult	6	104.3	98.3	6.0	100.55		
l. mexicanus	♀ adult	4	101.3	99.0	2.3	100.22		
l. sonoriensis	♂ adult	36	105.7	99.3	6.4	102.09±0.18	1.66±0.13	1.62±0.12
l. sonoriensis	♀ adult	26	104.7	98.5	6.2	101.23±0.25	1.89±0.17	1.86±0.17
l. grinnelli	♂ adult	7	102.9	99.2	3.7	101.04		
l. nelsoni	♂ adult	5	102.7	97.4	5.3	99.70		
l. nelsoni	♀ adult	7	99.2	93.1	6.1	96.02		
l. nevadensis	♂ adult	24	102.6	98.5	4.1	100.22±0.15	1.14±0.11	1.13±0.12
l. nevadensis	♀ adult	14	101.0	94.6	6.4	98.16		
l. gambeli O.	♂ adult	9	102.2	97.1	5.1	99.74		
l. gambeli O.	♀ adult	8	99.7	94.8	4.9	97.51		
l. gambeli S.	♂ adult	8	102.2	98.6	3.6	100.32		
l. gambeli S.	♀ adult	10	99.6	94.2	5.4	97.63		
l. gambeli S.F.	♂ adult	20	102.6	96.8	5.8	99.87±0.28	1.85±0.19	1.85±0.19
l. gambeli S.F.	♀ adult	14	99.2	94.9	4.3	97.32±0.24	1.37±0.17	1.40±0.17
l. gambeli L.A.	♂ adult	24	102.4	96.5	5.9	99.62±0.22	1.66±0.16	1.66±0.16
l. gambeli L.A	♀ adult	22	99.7	95.0	4.7	97.22±0.16	1.16±0.11	1.19±0.12
l. anthonyi	♂ adult	13	99.0	93.6	5.4	96.40±0.26	1.40±0.18	1.45±0.19
l. anthonyi	♀ adult	6	98.0	93.4	4.6	97.75		
l. mearnsi	♂ adult	5	99.5	95.3	4.2	97.64		

O.=*gambeli* from Oregon, Washington, northeastern California, etc.; S.=*gambeli* from the San Joaquin and Sacramento valleys, California, north of Tulare County; S.F.=*gambeli* from the vicinity of San Francisco Bay, California; L.A.=*gambeli* from the vicinity of Los Angeles, California.

of the same race. *Nevadensis* is a little lower than might be expected, yet it is not so migratory as the northern populations of *gambeli*.

Variation in wing and tail length with the ratio between the two constant is doubtless somewhat affected by the general size or bulk of the bird. In *sonoriensis* and *gambeli*, however, where something is

known of weight (see table 14, p. 104) it will be seen that *sonoriensis* is slightly lighter in weight, certainly not heavier, than *gambeli*, yet *sonoriensis* has a much greater wing and tail length despite its non-migratory habit. Similar differences may be pointed out in a comparison of *gambeli* and *nevadensis*, and *gambeli* and *nelsoni*.

TABLE 13

Geographic Variation in Length of Tail

Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e. borealis	♂ adult	3	116.0	109.8	6.2	113.23	....	....
e. borealis	♂ first-year	21	114.3	105.0	9.3	110.60±0.40	2.72±0.28	2.45±0.25
e. borealis	♀ adult	6	115.6	108.9	6.7	111.35	....	....
e. borealis	♀ first-year	22	114.4	105.8	8.6	108.76±0.29	2.05±0.20	1.88±0.19
e. invictus	♂ adult	11	124.4	115.0	7.4	117.59±0.44	2.17±0.31	1.84±0.27
e. invictus	♂ first-year	29	118.9	111.2	7.7	114.75±0.28	2.28±0.20	1.98±0.17
e. invictus	♀ adult	5	117.0	108.6	8.5	113.00	....	....
e. invictus	♀ first-year	30	117.6	107.4	10.2	112.98±0.35	2.84±0.24	2.51±0.21
l. ludovicianus	♂ adult	44	106.5	96.9	9.6	102.77±0.31	2.99±0.21	2.90±0.20
l. ludovicianus	♀ adult	31	104.5	96.6	7.9	99.37±0.27	2.28±0.19	2.29±0.19
l. migrans	♂ adult	17	100.8	94.0	6.8	98.25±0.43	2.65±0.30	2.69±0.31
l. migrans	♀ adult	16	101.7	93.8	7.9	97.52±0.42	2.53±0.30	2.59±0.30
l. excubitorides	♂ adult	12	103.1	96.6	6.5	100.00±0.45	2.33±0.32	2.33±0.32
l. excubitorides	♀ adult	6	99.5	93.0	6.5	96.41	....	....
l. mexicanus	♂ adult	6	108.0	101.2	6.8	103.31	....	....
l. mexicanus	♀ adult	5	104.5	102.0	2.5	103.55	....	....
l. sonoriensis	♂ adult	32	112.0	101.9	10.1	106.69±0.21	2.17±0.17	2.03±0.17
l. sonoriensis	♀ adult	27	109.5	101.1	8.4	105.35±0.29	2.24±0.20	2.12±0.19
l. grinnelli	♂ adult	7	108.5	100.8	7.7	105.27	....	....
l. nelsoni	♂ adult	7	102.7	96.6	6.1	100.37	....	....
l. nelsoni	♀ adult	8	102.7	94.7	8.0	98.52	....	....
l. nevadensis	♂ adult	27	106.6	97.3	9.3	102.42±0.41	3.17±0.29	3.09±0.38
l. nevadensis	♀ adult	16	104.3	96.4	7.9	100.37	....	....
l. gambeli O.	♂ adult	10	106.5	98.0	8.5	101.24	....	....
l. gambeli O.	♀ adult	8	101.8	97.5	4.3	99.22	....	....
l. gambeli S.	♂ adult	8	105.3	97.0	8.3	102.00	....	....
l. gambeli S.	♀ adult	10	105.0	100.0	5.0	101.71	....	....
l. gambeli S.F.	♂ adult	19	108.0	99.2	8.8	103.90±0.35	2.27±0.24	2.18±0.23
l. gambeli S.F.	♀ adult	15	103.4	96.5	6.9	99.43±0.34	1.99±0.24	2.00±0.25
l. gambeli L.A.	♂ adult	25	107.1	97.5	9.6	102.26±0.35	2.63±0.25	2.57±0.24
l. gambeli L.A.	♀ adult	23	105.7	96.8	8.9	99.44±0.36	2.57±0.25	2.58±0.25
l. anthonyi	♂ adult	13	102.7	96.4	6.3	99.53±0.53	2.86±0.37	2.87±0.38
l. anthonyi	♀ adult	6	101.7	96.6	5.1	98.70	....	....
l. mearnsi	♂ adult	5	102.0	98.3	3.7	100.28	....	....

Irrespective of the bulk of the bird, then, there is an increase of wing and tail length which is found to be associated with a sparseness of trees and bushes in the habitat. On the average the habitats of *nelsoni*, *nevadensis*, and particularly *sonoriensis* are more sparsely grown with trees and bushes than is the habitat of *gambeli*, which is a comparatively short winged bird. In the more open habitats it is neces-

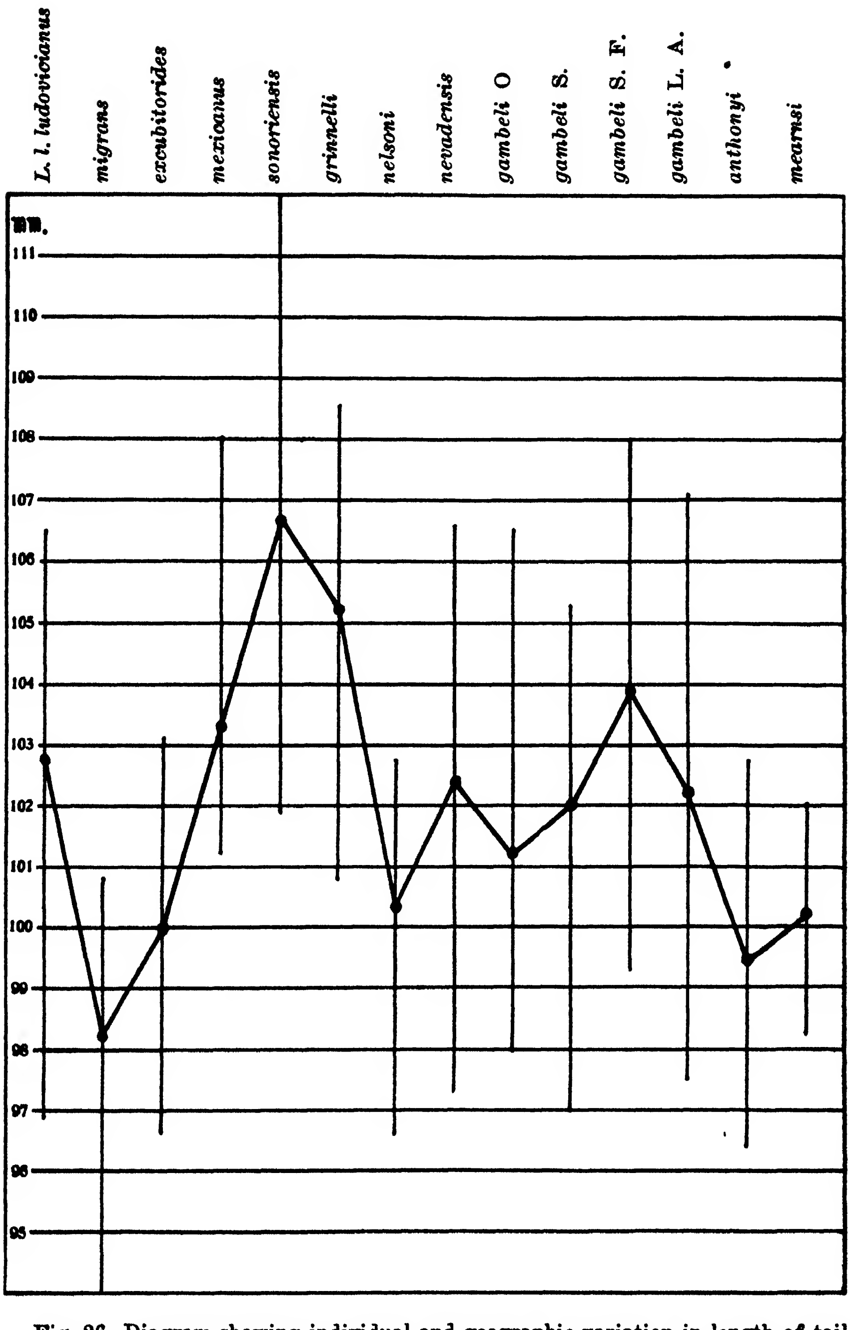

Fig. 26. Diagram showing individual and geographic variation in length of tail of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

sary for shrikes to fly longer distances in going from perch to perch and in seeking the food supply, which is often not so concentrated in open, desert regions as in areas of denser vegetation. Field observations confirming this point have been made in the case of *gambeli* and *nevadensis* (see p. 156). *Anthonyi* and *mearnsi* possess short wings

TABLE 14

WEIGHTS (IN GRAMS) OF SHRIKES

Race	Sex	Age	Number of specimens	Maximum	Minimum	Mean
e. invictus	♂	first-year	1	67.5	67.5	67.50
l. sonoriensis	♂	adult	1	48.0	48.0	48.00
l. sonoriensis	♂	first-year	2	46.7	44.0	43 06
l. sonoriensis	♀	adult	2	47.4	46.7	47.05
l. sonoriensis	♀	first-year	1	45.0	45.0	45.00
l. sonoriensis	total		6	48 0	44.0	46.30
l. grinnelli	♂	adult	3	49.1	43.7	45.60
l. grinnelli	♂	first-year	3	49 3	45.0	46.40
l. grinnelli	♀	first-year	1	43.7	43.7	43.70
l. grinnelli	total		7	49.3	43.7	45.94
l. nelsoni	♂	first-year	8	47.5	41.5	44.22
l. nelsoni	♀	adult	4	47.0	40.0	43.32
l. nelsoni	♀	first-year	7	46 6	40.5	43.61
l. nelsoni	total		19	47.5	40.0	43.78
l. nevadensis	♂	adult	10	51 9	40 0	46.50
l. nevadensis	♂	first-year	5	47.9	42.0	44.90
l. nevadensis	♀	adult	3*	53.9	45.5	49.06
l. nevadensis	♀	first-year	5	45.7	42.5	44.20
l. nevadensis	total		23	53.9	40.0	45.98
l. gambeli	♂	adult	10	54.5	44.7	50.05
l. gambeli	♂	first-year	16	54.5	44.8	48.65
l. gambeli	♀	adult	11	58.0*	44.8	50.06
l. gambeli	♀	first-year	12	55.7*	43.0	47.63
l. gambeli	total		49	58.0	43.0	49.00

* Laying.

and tail presumably by reason of their habitat on the Santa Barbara Islands, where they frequent the steep narrow cañons and brushy hillsides. Long flights are probably not often indulged in by them. *Migrans* and *L. l. ludovicianus* are short-winged forms compared with *excubitorides* and *mexicanus*, both the *former* inhabiting comparatively wooded regions. The weight relations between the eastern forms are not known, however, the small size of the feet and wings

of *migrans* and *L. l. ludovicianus* perhaps indicating a smaller bulk in these races.

The variations in the three measurements taken of the feet show a fair degree of similarity. It will be seen from the diagrams

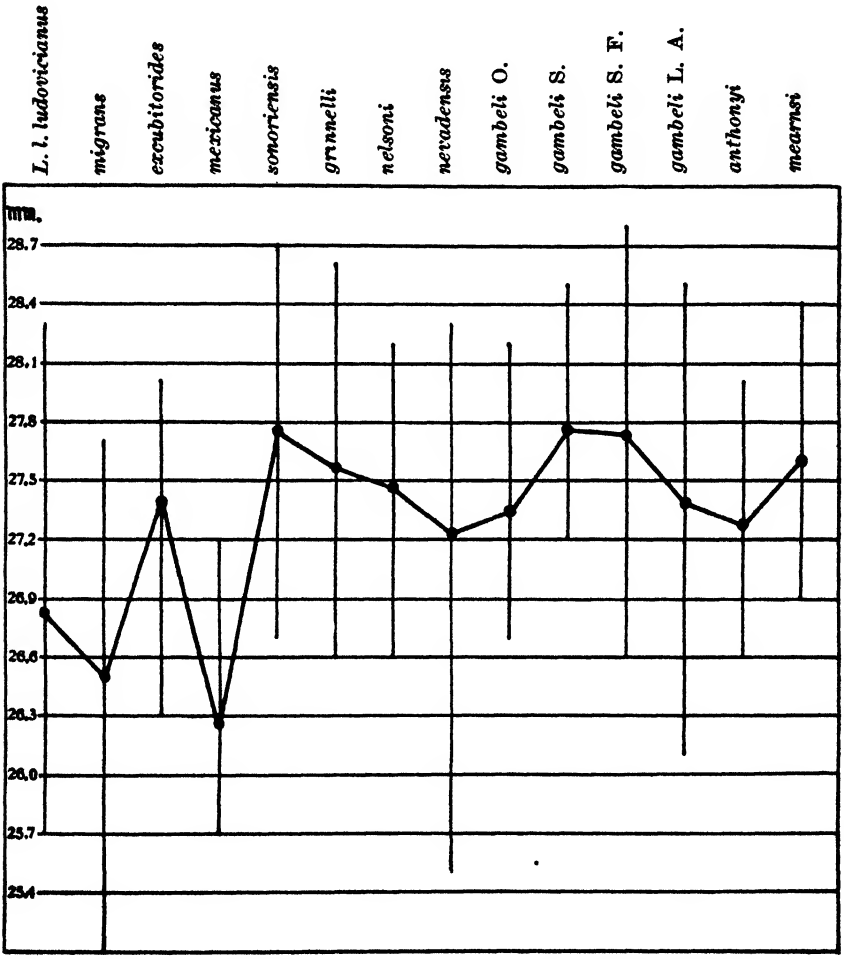

Fig. 27. Diagram showing individual and geographic variation in length of tarsometatarsus of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

that *L. l. ludovicianus*, *migrans*, and *mexicanus* possess small feet. *Excubitorides*, although possessing short toes, has a moderately long metatarsus. It is thought that in some degree the metatarsus may indicate roughly, within the species, the bulk of the bird, but sufficient figures are not available to establish this point. Associated with the

short wings of the island races, *anthonyi* and *mearnsi*, is a set of measurements indicating strong, large feet. This is a tendency in insular forms frequently noted (Lucas, 1891) and indicates a loss in wing power. In contrast with this association of short wings and large feet,

TABLE 15

GEOGRAPHIC VARIATION IN LENGTH OF TARSOMETATARSUS

Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e. borealis	♂ adult	3	26.0	25.7	0.3	25 90	....	....
e. borealis	♂ first-year	21	27.0	25.1	1 9	26.40±0 09	0.58±0 06	2 19±0.22
e. borealis	♀ adult	6	27.2	25.2	2 0	26.15	....	....
e. borealis	♀ first-year	22	26.9	25.1	1 8	25.90±0 07	0.48±0.05	1.85±0 18
e. invictus	♂ adult	12	27.8	26.3	1 5	27 14±0 08	0 43±0 06	1.58±0 21
e. invictus	♂ first-year	30	28.4	25.9	2.6	27.03±0.07	0 53±0 05	1.96±0.17
e. invictus	♀ adult	5	28 0	26 9	1.1	27 36	....	....
e. invictus	♀ first-year	28	27.8	25.9	1.9	26.88±0 05	0 57±0 05	2 12±0 19
l. ludovicianus	♂ adult	43	28 3	25 7	2 6	26 83±0 07	0 66±0 05	2 45±0.17
l. ludovicianus	♀ adult	31	27.8	25 0	2 8	26 48±0 08	0 66±0 06	2 59±0 21
l. migrans	♂ adult	18	27.7	25.1	2.6	26.51±0 12	0 81±0 09	3 05±0 34
l. migrans	♀ adult	16	27 2	25 7	1 5	26 56±0 08	0.45±0 05	1 69±0 20
l. excubitorides	♂ adult	13	28 0	26 3	1.7	27 40±0 10	0.55±0 07	2.00±0 26
l. excubitorides	♀ adult	7	27.8	26 0	1.8	26 87	....	....
l. mexicanus	♂ adult	7	27.2	25 7	1 5	26 27	....	....
l. mexicanus	♀ adult	5	28 0	26 4	1.6	26 92	....	....
l. sonoriensis	♂ adult	38	28.7	26.7	2 0	27.76±0 06	0 56±0 04	2 01±0 15
l. sonoriensis	♀ adult	28	28.7	25 9	2.8	27.38±0 09	0 70±0 06	2.55±0 23
l. grinnelli	♂ adult	7	28 6	26.6	2 0	27 57	....	....
l. nelsoni	♂ adult	7	28.2	26 6	1 6	27 48	....	....
l. nelsoni	♀ adult	9	27.4	24.8	2 6	26 55	....	....
l. nevadensis	♂ adult	30	28 3	25 5	2 8	27 22±0 09	0.73±0 06	2.68±0 23
l. nevadensis	♀ adult	16	28.3	26.0	2 3	27 30	....	....
l. gambeli O.	♂ adult	10	28.2	26.7	1 5	27.35	....	....
l. gambeli O.	♀ adult	9	27.7	25 3	2.4	26 73	....	....
l. gambeli S.	♂ adult	8	28.5	27.2	1 3	27 78	....	....
l. gambeli S.	♀ adult	10	28.4	26.4	2 0	27 28	....	....
l. gambeli S.F.	♂ adult	20	28.8	26 6	2 2	27.72±0 10	0.66±0 07	2 38±0 25
l. gambeli S.F.	♀ adult	16	28.9	25.5	3 4	27.35±0 04	0.87±0 10	3.18±0 37
l. gambeli L.A.	♂ adult	25	28.5	26 1	2.4	27.39±0.09	0 69±0 07	2 51±0 24
l. gambeli L.A.	♀ adult	23	28.3	26 0	2 3	27.25±0.09	0 61±0 06	2 23±0 22
l. anthonyi	♂ adult	14	27.9	26.6	1.3	27.29±0 12	0 70±0 09	2.56±0.33
l. anthonyi	♀ adult	6	27.8	26 3	1.5	27.20	....	....
l. mearnsi	♂ adult	5	28.4	26.9	1.5	27.60	....	....

we find in *L. l. ludovicianus* both short wings and small feet; as previously stated the feet in this case perhaps signify small size. However, there are numerous unknown factors in the behavior of the various races which may influence development of the feet. Among these might be suggested the influence of hopping through dense thickets as contrasted with activities in an open prairie habitat, which latter would tend to lengthen the metatarsus. Also, the different uses

of the foot in manipulating prey probably are important. *Borealis* and *invictus* which frequent more wooded areas and as nearly as can be judged use the feet more often in grasping prey possess shorter, stockier metatarsi and toes than do any of the members of *L. ludovicianus*. It might be pointed out that within the *excubitor* group are

TABLE 16

GEOGRAPHIC VARIATION IN LENGTH OF MIDDLE TOE

Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e borealis	♂ adult	3	12 2	11 7	0 5	12 03		
e borealis	♂ first-year	21	12 5	11 2	1 3	12 03±0 06	0 44±0 05	3 65±0 37
e borealis	♀ adult	6	12 5	11 5	1 0	12 20		
e borealis	♀ first-year	21	12 6	11 2	1 4	11 92±0 05	0 33±0 03	2 76±0 28
e invictus	♂ adult	12	13 1	12 0	1 1	12 55±0 08	0 40±0 06	3 18±0 43
e invictus	♂ first-year	28	13 0	11 8	1 2	12 32±0 04	0 35±0 03	2 84±0 25
e invictus	♀ adult	5	12 7	12 1	0 6	12 37		
e invictus	♀ first-year	28	12 8	11 7	1 1	12 24±0 03	0 24±0 02	1 96±0 17
l ludovicianus	♂ adult	44	13 4	12 3	1 1	12 91±0 04	0 40±0 03	3 09±0 23
l ludovicianus	♀ adult	30	13 4	11 8	1 6	12 70±0 05	0 43±0 04	3 38±0 29
l migrans	♂ adult	17	13 4	12 1	1 3	13 01±0 07	0 45±0 05	3 45±0 39
l migrans	♀ adult	16	13 5	12 2	1 3	12 96±0 06	0 37±0 04	2 85±0 34
l excubitorides	♂ adult	13	13 6	12 6	1 0	13 13±0 07	0 37±0 05	2 81±0 37
l excubitorides	♀ adult	7	13 8	12 6	1 2	13 22		
l mexicanus	♂ adult	6	13 4	12 3	1 1	12 91		
l mexicanus	♀ adult	5	13 6	12 1	1 5	13 00		
l sonoriensis	♂ adult	37	14 4	12 7	1 7	13 42±0 06	0 51±0 04	3 80±0 29
l sonoriensis	♀ adult	28	14 3	12 0	2 3	13 06±0 08	0 64±0 06	4 90±0 45
l grinnelli	♂ adult	7	13 6	12 8	0 8	13 15		
l nelsoni	♂ adult	6	13 7	13 0	0 7	13 40		
l nelsoni	♀ adult	9	13 3	12 5	0 8	12 94		
l nevadensis	♂ adult	20	13 8	13 0	0 8	13 39±0 06	0 38±0 04	2 83±0 30
l nevadensis	♀ adult	8	13 8	12 3	1 5	13 13		
l gambeli O	♂ adult	10	13 8	12 8	1 0	13 26		
l gambeli O	♀ adult	9	14 1	12 4	1 7	13 13		
l gambeli S	♂ adult	8	14 0	12 6	1 4	13 30		
l gambeli S	♀ adult	10	13 9	12 5	1 4	13 16		
l gambeli S F	♂ adult	21	14 0	12 6	1 4	13 44±0 07	0 46±0 05	3 42±0 35
l gambeli S F	♀ adult	16	13 9	12 7	1 2	13 34±0 06	0 37±0 04	2 77±0 33
l gambeli L A	♂ adult	24	13 9	12 8	1 1	13 31±0 04	0 28±0 03	2 10±0 02
l gambeli L A	♀ adult	23	13 9	12 5	1 4	13 20±0 07	0 47±0 04	3 56±0 35
l anthonyi	♂ adult	13	13 9	13 2	0 7	13 56±0 04	0 21±0 03	1 54±0 20
l anthonyi	♀ adult	6	13 4	12 8	0 6	13 06		
l mearnsi	♂ adult	5	13 8	12 8	1 0	13 20		

to be found in arid southern Morocco such forms as *L. e. dodsoni* which closely parallels the American *ludovicianus* group and is possessed of extremely large feet.

Bill size and shape, especially bill length and the curvature of the tip, are highly variable individually even though certain characteristic types of bill prevail in each race. The decided importance of

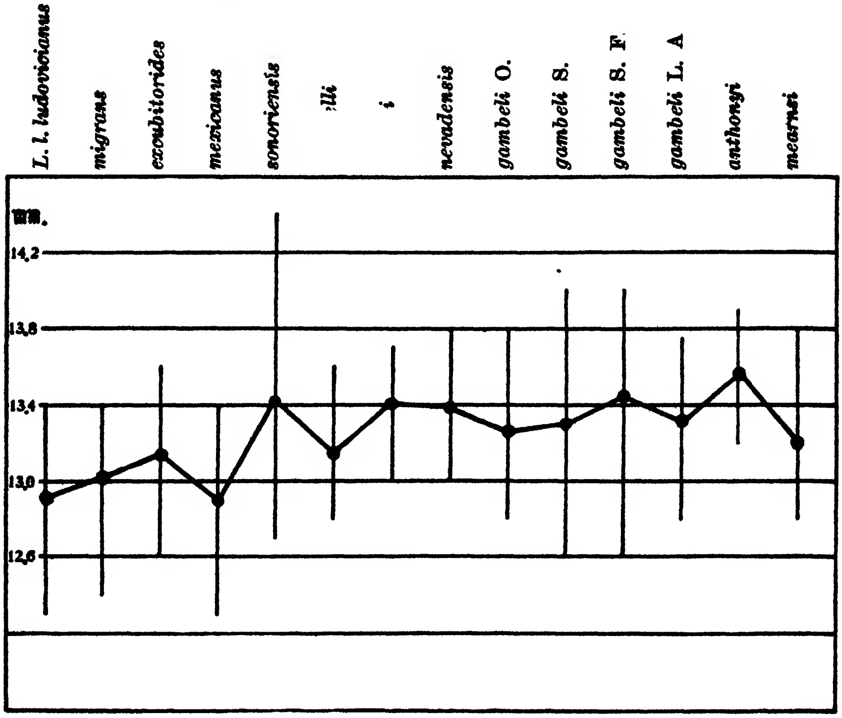

Fig. 28. Diagram showing individual and geographic variation in length of middle toe of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

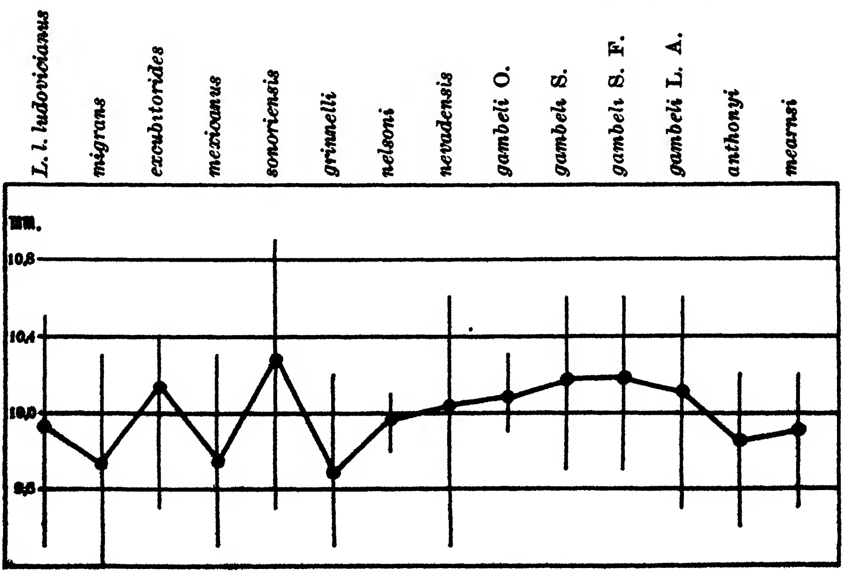

Fig. 29. Diagram showing individual and geographic variation in length of hind toe of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

the hook and tooth in the activities of captive shrikes has been observed repeatedly. If sufficient detail were known concerning impaling, attacking of prey, and food preferences in different races, some degree of correlation between variations in structure and use might

TABLE 17

GEOGRAPHIC VARIATION IN LENGTH OF HIND TOE

Measurements in millimeters

Geographic group	Sex and age	Number of speci-mens	Maxi-mum	Mini-mum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e. borealis	♂ adult	3	9 5	9 1	0 4	9 23	...	...
e. borealis	♂ first-year	21	9 9	8 8	1 1	9 39±0 04	0.30±0.03	3.19±0.33
e. borealis	♀ adult	6	9 7	9 0	0 7	9 33	...	...
e. borealis	♀ first-year	22	9 7	8 8	0 9	9 25±0.03	0 24±0 02	2.59±0.26
e. invictus	♂ adult	12	10.0	9 4	0 6	9 74±0.04	0.19±0.03	1.95±0.26
e. invictus	♂ first-year	29	10 4	9.0	1 4	9 65±0 04	0 33±0.03	3.41±0.30
e. invictus	♀ adult	5	10 0	9 6	0 4	9 82	...	...
e. invictus	♀ first-year	28	10 4	9 1	1 3	9 57±0 04	0 31±0 03	3.23±0.29
l. ludovicianus	♂ adult	43	10 5	9 3	1 2	9 94±0 03	0 33±0 02	3 31±0 24
l. ludovicianus	♀ adult	30	10 1	9 0	1 1	9 59±0 04	0 33±0 03	3.44±0 29
l. migrans	♂ adult	18	10 3	9 2	1 1	9 73±0 05	0 29±0 03	2.98±0 33
l. migrans	♀ adult	16	10 6	8 9	1 7	9 78±0 08	0.45±0 05	4 60±0 54
l. excubitorides	♂ adult	13	10 5	9 5	1 0	10 13±0 05	0 27±0 06	2.66±0 35
l. excubitorides	♀ adult	6	10 3	9 7	0 6	9 98	...	...
l. mexicanus	♂ adult	7	10 3	9 3	1 0	9.74	...	...
l. mexicanus	♀ adult	5	10 0	9 0	1.0	9 58	...	...
l. sonoriensis	♂ adult	38	10 9	9 5	1.4	10 28±0 04	0 36±0.03	3.50±0 28
l. sonoriensis	♀ adult	28	10 7	9 5	1.2	10 10±0 04	0 34±0 03	3.36±0 30
l. grinnelli	♂ adult	6	10 2	9 3	0 9	9 68	...	...
l. nelsoni	♂ adult	7	10 1	9 8	0 3	9 98	...	...
l. nelsoni	♀ adult	8	10 1	9 2	0 9	9 61	...	...
l. nevadensis	♂ adult	31	10 6	9.3	1 3	10 03±0 05	0.42±0 04	4.18±0 35
l. nevadensis	♀ adult	16	10 3	9 6	0 7	9 95	...	...
l. gambeli O.	♂ adult	10	10 3	9 9	0 4	10 08	...	...
l. gambeli O.	♀ adult	9	10 1	9 1	1 0	9 53	...	...
l. gambeli S.	♂ adult	9	10 6	9 7	0 9	10 18	...	...
l. gambeli S.	♀ adult	10	10 7	9 9	0 8	10 25	...	...
l. gambeli S.F.	♂ adult	20	10 6	9 7	0 9	10 18±0 04	0 28±0.03	2 77±0 29
l. gambeli S.F.	♀ adult	16	10 4	9 5	0 9	9 93±0 05	0 29±0 03	2.92±0 34
l. gambeli L.A.	♂ adult	24	10 6	9 5	1 1	10 11±0 04	0 31±0 03	3.09±0 30
l. gambeli L.A.	♀ adult	23	10 5	9 5	1 0	10 06±0 06	0 41±0.04	4.07±0.40
l. anthonyi	♂ adult	14	10 2	9 4	0 8	9.87±0 04	0 22±0 03	2.22±0 28
l. anthonyi	♀ adult	6	10 1	9 0	1 1	9.56	...	...
l. mearnsi	♂ adult	5	10.2	9 5	0 7	9 92	...	...

be deciphered. At present this is impossible. For the most part data on the food of Loggerhead Shrikes fail to record the subspecies involved, and, as has been mentioned, sufficiently critical field studies of behavior connected with feeding are not recorded in the literature. The geographic structural variations of the bill are best described in the accompanying diagrams and tables.

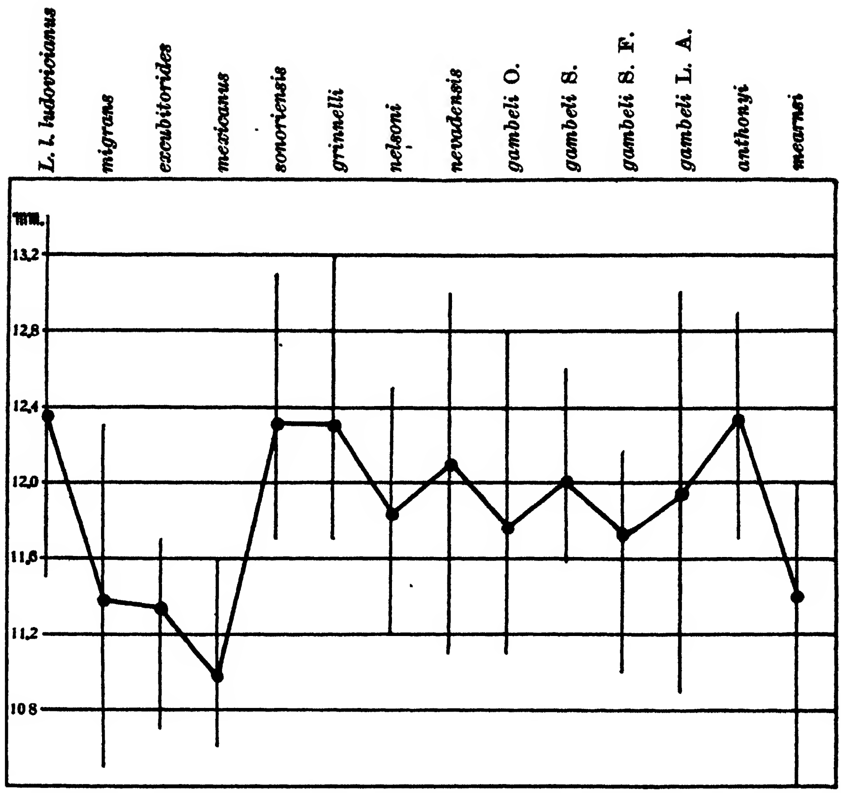

Fig. 30. Diagram showing individual and geographic variation in length of bill of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

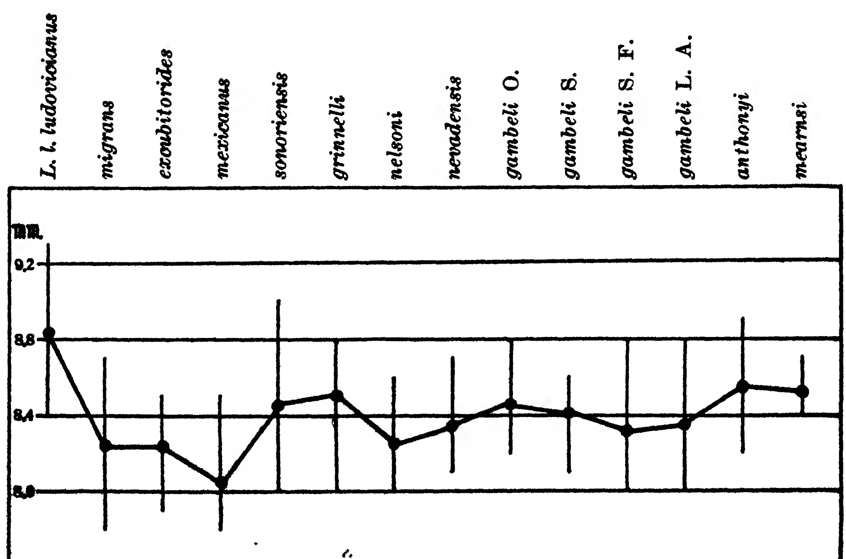

Fig. 31. Diagram showing individual and geographic variation in depth of bill of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

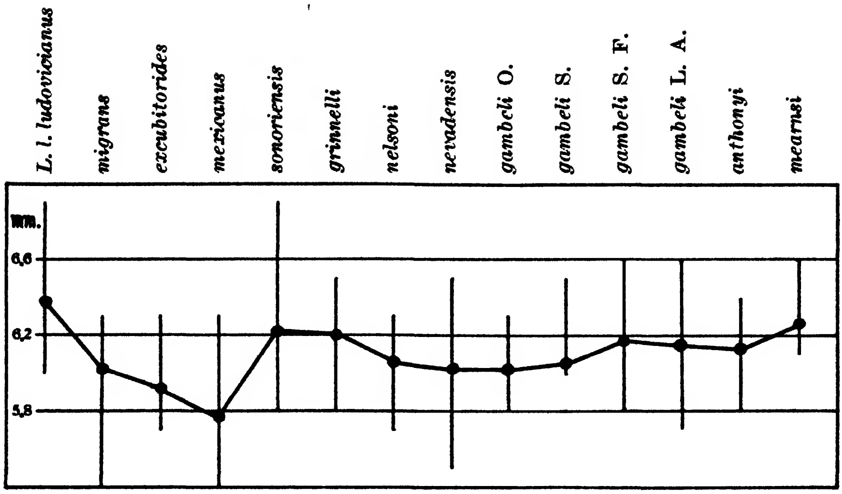

Fig. 32. Diagram showing individual and geographic variation in width of bill of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages.

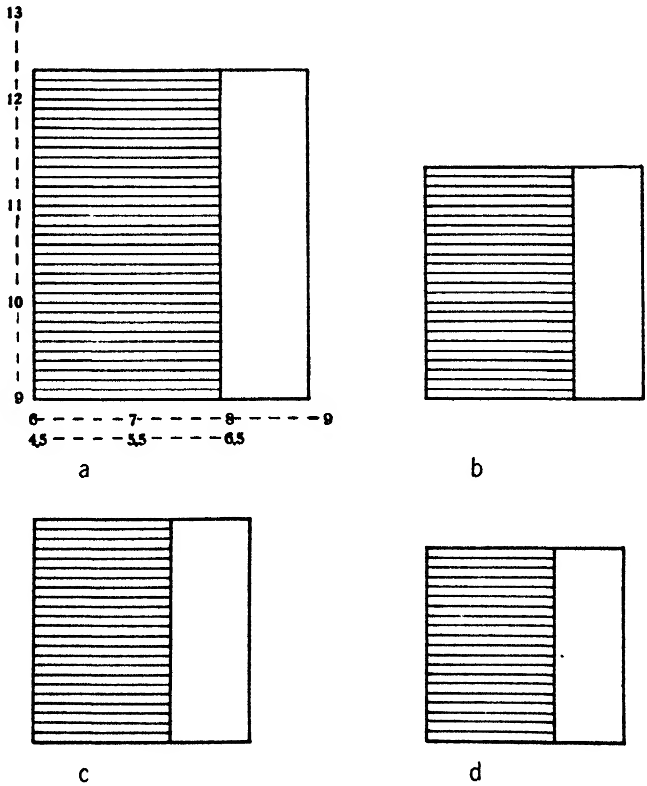

Fig. 33. Ideograms illustrating geographic variation in proportions of bill. a, *L. l. ludovicianus;* b, *L. l. migrans;* c, *L. l. excubitorides;* d, *L. l. mexicanus.* Height of rectangles indicates length of bill in excess of 9 mm.; total width of rectangles indicates depth of bill in excess of 6 mm.; width of shaded rectangles indicates width of bill in excess of 4.5 mm.

Geographic variations in the structure and size of the bill and in size of wing, tail, and feet in Loggerhead Shrikes do not appear to be correlated with latitude as simply as Allen (1877) has suggested. In the case of wing and tail length other factors definitely are of importance as has been pointed out. Bill size does not increase to the southward throughout the species, *mexicanus* possessing an extremely small bill. Snodgrass (1902) in dealing with bill size in

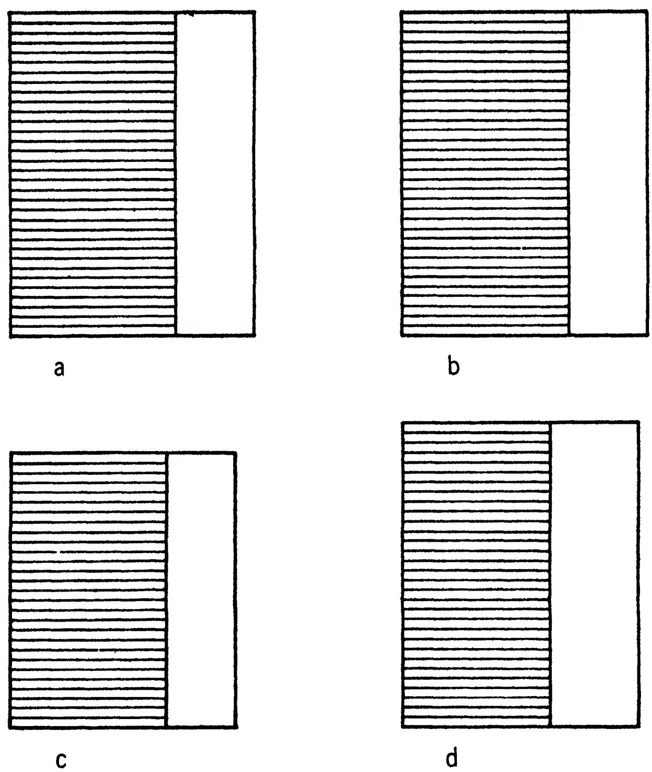

Fig. 34. Ideograms illustrating geographic variation in proportions of bill. a, *L. l. sonoriensis;* b, *L. l. grinnelli;* c, *L. l. nelsoni;* d, *L. l. nevadensis.* For explanation see figure 33.

Geospiza of the Galapagos Islands and Linsdale (1928*b*) in his study of the bill of *Passerella* both have found that variation in bill size in these groups of fringillids is not associated with variation in diet. These negative findings, however, do not apply, necessarily, to shrikes.

The white patch at the bases of the primaries is usually associated with variation in the color of the upper parts and, accordingly, with variations in humidity and rainfall. *Mexicanus* possesses a surprisingly large wing patch but, nevertheless, not so large as the primary

area in the adjacent light-backed forms, *excubitorides* and *sonoriensis*. It is conceivable that changes in the color of the upper surface constitute the principal or more immediate response to varying rainfall and humidity and that the primary white area is in some way linked with the factors for dorsal pigmentation, for I fail to see the adaptive significance of small variations in the extent of the wing spot. Likewise, associated with this same series of pigment changes is the small

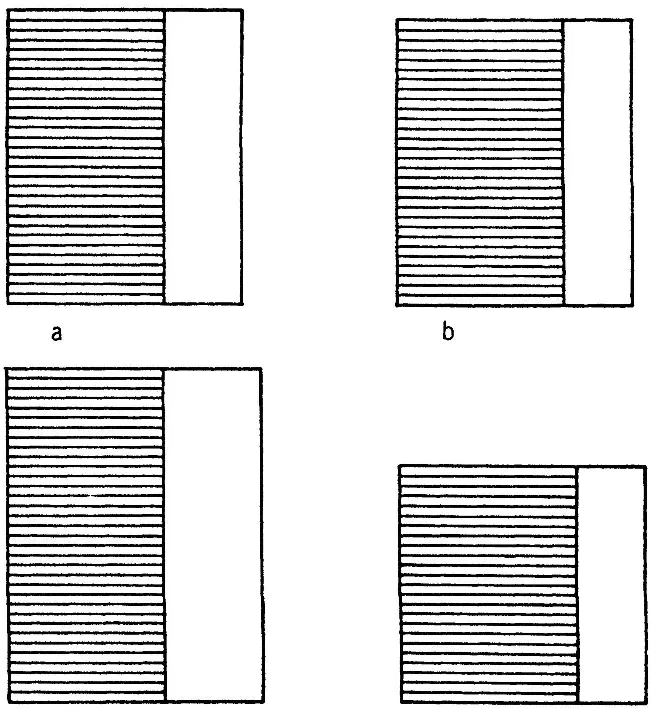

Fig. 35. Ideograms illustrating geographic variation in proportions of bill. a, *L. l. gambeli* S.; b, *L. l. gambeli* L. A.; c, *L. l. anthonyi;* d, *L. l. mearnsi.* For explanation see figure 33.

amount of variation found in the white tips and edgings of the dorsal wing coverts and remiges.

The white tippings of the tail, particularly as measured by the white tip on the outer rectrix, afford a character of unusual interest. It is surprising to find that this feature is not always closely correlated with the variation in the primary white areas. On the basis of the white on the rectrices, the eleven races may be divided into two groups, the same groupings as those made in the case of the vermiculations

of the breast. The first group includes *L. l. ludovicianus, migrans,* and *excubitorides,* and the second, all the other subspecies, those with small white spots on the rectrices. Within each of these two groups, however, there is a tendency for those races with lighter colored upper parts to possess more white on the tail. As with the primary wing

TABLE 18

GEOGRAPHIC VARIATION IN LENGTH OF BILL

Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e. borealis	♂ adult	3	14 3	13 6	0.7	13 83	......	......
e. borealis	♂ first-year	21	14 6	13.1	1.5	13.90±0 06	0.43±0 04	3.09±0.32
e. borealis	♀ adult	6	13 7	13 0	0.7	13.38	......	......
e. borealis	♀ first-year	21	14.7	12.8	1.9	13 56±0 07	0 48±0 05	3.53±0 36
e. invictus	♂ adult	12	14.6	13 1	1.5	13 96±0 08	0 42±0 06	3.00±0 41
e. invictus	♂ first-year	30	14.7	13 0	1.7	13 95±0 05	0 39±0 03	2.79±0 24
e. invictus	♀ adult	5	14.0	13 2	0 6	13 36	......	......
e. invictus	♀ first-year	27	14.6	12 9	1 7	13.73±0 05	0 41±0.04	2 98±0 27
l. ludovicianus	♂ adult	43	13 4	11 5	1 9	12 36±0 05	0 51±0 04	4 12±0 29
l. ludovicianus	♀ adult	30	13 1	11.2	1 9	12.02±0.04	0 33±0 03	2 74±0 24
l. migrans	♂ adult	18	12 3	10 5	1.8	11.38±0.09	0 57±0 06	5.00±0.56
l. migrans	♀ adult	16	12 3	10 6	1 7	11.60±0.09	0 55±0 07	4.74±0 56
l. excubitorides	♂ adult	13	11 7	10 7	1 0	11 32±0 05	0 28±0 04	2.48±0 37
l. excubitorides	♀ adult	7	11 7	11 1	0.6	11 30	......	......
l. mexicanus	♂ adult	7	11.6	10 6	1.0	10 98	......	......
l. mexicanus	♀ adult	4	11 7	11.4	0 3	11.57	......	......
l. sonoriensis	♂ adult	39	13.1	11.7	1.4	12.31±0 04	0.41±0 03	3 33±0 25
l. sonoriensis	♀ adult	29	12.4	11.0	1.4	11 93±0 04	0 34±0 03	2 84±0 25
l. grinnelli	♂ adult	7	13 2	11.7	1 5	12 30	......	......
l. nelsoni	♂ adult	7	12 5	11 2	1.3	11.83	......	......
l. nelsoni	♀ adult	7	12 7	11 4	1 3	11 84	......	......
l. nevadensis	♂ adult	29	13.0	11 1	1.9	12 10±0 06	0 51±0.05	4.21±0 37
l. nevadensis	♀ adult	15	12 8	11 0	1 8	11.82	......	......
l. gambeli O.	♂ adult	10	12 8	11 1	1 7	11.77	......	......
l. gambeli O.	♀ adult	9	12.0	11 0	1 0	11.55	......	......
l. gambeli S.	♂ adult	8	12 6	11.6	1.0	12 01	......	......
l. gambeli S.	♀ adult	10	12 5	11.1	1.4	11.73	......	......
l. gambeli S.F.	♂ adult	20	12.2	11.0	1 2	11.71±0 07	0.47±0.05	4 01±0 42
l. gambeli S.F.	♀ adult	15	12 2	10.9	1.3	11 65±0.09	0 54±0 07	4 63±0.57
l. gambeli L.A.	♂ adult	24	13.0	10 9	2.1	11.94±0 08	0.60±0 06	5 02±0 48
l. gambeli L.A.	♀ adult	23	12 5	10.9	1 6	11.58±0.08	0.54±0.05	4.66±0.46
l. anthonyi	♂ adult	13	12.9	11.7	1.2	12.35±0 10	0.55±0.07	4 45±0.58
l. anthonyi	♀ adult	6	13.0	11 4	1.6	12.08	......	......
l. mearnsi	♂ adult	5	12.0	10.4	1.6	11.40	......	......

spot, there is no known adaptive significance to be attributed to the variations in the extent of the white tail markings. These markings show wide individual variation, the magnitude of which would seem to indicate a lack of any potent selective value. Again, it is thought that, within each of the two primary divisions of the species, the control of the white tail areas is in some way linked with the dorsal

pigmentation. The probable genetic basis for the production of the tail spots has been discussed (p. 23).

In summing up the kinds of geographic variations in *L. ludovicianus* four principal types are found to occur: first, those variations in coloration which seem to be correlated with climate, either directly

TABLE 19

GEOGRAPHIC VARIATION IN DEPTH OF BILL

Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e borealis	♂ adult	3	8 9	8 5	0 4	8 66		
e borealis	♂ first-year	20	9 1	8 4	0 7	8 78±0 03	0 21±0 02	2 39±0 25
e borealis	♀ adult	6	9 0	8 4	0 6	8 73		
e borealis	♀ first-year	19	9 1	8 2	0 8	8 50±0 04	0 24±0 03	2 28±0 30
e invictus	♂ adult	9	9 6	8 9	0 7	9 16		
e invictus	♂ first-year	28	9 3	8 5	0 8	8 91±0 03	0 20±0 02	2 24±0 20
e invictus	♀ adult	5	8 9	8 3	0 6	8 62		
e invictus	♀ first-year	21	9 1	8 4	0 7	8 80±0 03	0 20±0 02	2 27±0 23
l ludovicianus	♂ adult	34	9 3	8 4	0 9	8 83±0 02	0 21±0 02	2 37±0 19
l ludovicianus	♀ adult	26	9 0	8 1	0 9	8 65±0 03	0 25±0 02	2 89±0 03
l migrans	♂ adult	17	8 7	7 8	0 9	8 24±0 04	0 23±0 03	2 79±0 03
l migrans	♀ adult	9	8 8	7 9	0 9	8 20		
l excubitorides	♂ adult	9	8 5	7 9	0 6	8 24		
l excubitorides	♀ adult	5	8 5	8 1	0 3	8 24		
l mexicanus	♂ adult	6	8 5	7 8	0 7	8 05		
l mexicanus	♀ adult	5	8 7	7 9	0 8	8 19		
l sonoriensis	♂ adult	29	9 0	8 0	1 0	8 45±0 03	0 23±0 02	2 72±0 22
l sonoriensis	♀ adult	24	8 7	8 0	0 7	8 34±0 03	0 19±0 02	2 27±0 22
l grinnelli	♂ adult	7	8 8	8 0	0 8	8 51		
l nelsoni	♂ adult	6	8 6	8 0	0 6	8 26		
l nelsoni	♀ adult	6	9 0	7 6	1 4	8 20		
l nevadensis	♂ adult	27	8 7	8 1	0 6	8 35±0 02	0 18±0 02	2 15±0 19
l nevadensis	♀ adult	14	8 7	7 9	0 8	8 15		
l gambeli O	♂ adult	8	8 8	8 2	0 6	8 46		
l gambeli O	♀ adult	9	8 4	7 9	0 5	8 12		
l gambeli S	♂ adult	6	8 6	8 1	0 5	8 41		
l gambeli S	♀ adult	10	8 6	7 9	0 7	8 26		
l gambeli S F	♂ adult	17	8 8	8 0	0 8	8 31±0 03	0 21±0 03	2 52±0 29
l gambeli S F	♀ adult	13	8 6	7 9	0 7	8 13±0 05	0 27±0 04	3 32±0 43
l gambeli L A	♂ adult	24	8 8	8 0	0 8	8 37±0 03	0 20±0 02	2 38±0 23
l gambeli L A	♀ adult	18	8 6	8 0	0 6	8 30±0 02	0 15±0 02	1 80±0 20
l anthonyi	♂ adult	14	8 9	8 2	0 7	8 57±0 04	0 21±0 03	2 45±0 31
l anthonyi	♀ adult	5	8 6	7 7	0 9	8 20		
l mearnsi	♂ adult	5	8 7	8 4	0 3	8 52		

or indirectly, this category being comprised of two separate series of variables, (*a*) the coloration of the upper parts and the white areas of the remiges, and (*b*) the coloration of the under parts and scapulars; second, color variations of the rump, white areas of the tail, and the vermiculations of the under parts; each of these three characters appears to mark a division of the species into two principal, although

not perfectly coincident, groups and also, aside from this division into large groupings, shows some correlation with the climate of the environment; third, characters of size and ratio of wing and tail, which are correlated with powers of flight either as regards migration or openness of the habitat; and, fourth, characters of bill and feet,

TABLE 20

GEOGRAPHIC VARIATION IN WIDTH OF BILL

Measurements in millimeters

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent)
e. borealis	♂ adult	3	6.9	6.3	0.6	6.50	....	....
e. borealis	♂ first-year	20	6.7	6.1	0.6	6.47±0.02	0.16±0.02	2.47±0.26
e. borealis	♀ adult	6	7.1	6.2	0.9	6.51	....	....
e. borealis	♀ first-year	22	6.8	5.9	0.9	6.37±0.04	0.25±0.03	3.92±0.39
e. invictus	♂ adult	12	6.9	6.3	0.6	6.62±0.04	0.20±0.03	3.02±0.41
e. invictus	♂ first-year	30	7.0	6.0	1.0	6.49±0.03	0.26±0.02	4.00±0.34
e. invictus	♀ adult	5	6.8	6.0	0.8	6.36	....	....
e. invictus	♀ first-year	28	6.8	6.0	0.8	6.40±0.03	0.22±0.02	3.43±0.30
l. ludovicianus	♂ adult	43	6.9	6.0	0.9	6.39±0.03	0.26±0.02	4.06±0.29
l. ludovicianus	♀ adult	31	6.8	5.9	0.9	6.32±0.03	0.26±0.02	4.14±0.35
l. migrans	♂ adult	18	6.3	5.4	0.9	6.02±0.04	0.28±0.03	4.65±0.52
l. migrans	♀ adult	15	6.5	5.7	0.8	5.95±0.04	0.24±0.03	4.04±0.49
l. excubitorides	♂ adult	13	6.3	5.7	0.6	5.92±0.03	0.16±0.02	2.70±0.35
l. excubitorides	♀ adult	6	6.2	5.6	0.6	5.93	....	....
l. mexicanus	♂ adult	7	6.3	5.4	0.9	5.78	....	....
l. mexicanus	♀ adult	5	6.1	5.8	0.3	5.94	....	....
l. sonoriensis	♂ adult	38	6.9	5.8	1.1	6.21±0.03	0.28±0.02	4.50±0.34
l. sonoriensis	♀ adult	27	6.5	5.7	0.8	6.10±0.03	0.23±0.02	3.77±0.34
l. grinnelli	♂ adult	7	6.5	5.8	0.7	6.20	....	....
l. nelsoni	♂ adult	7	6.3	5.7	0.6	6.07	....	....
l. nelsoni	♀ adult	7	6.3	5.6	0.7	5.94	....	....
l. nevadensis	♂ adult	30	6.5	5.5	1.0	6.02±0.03	0.28±0.02	4.65±0.57
l. nevadensis	♀ adult	16	6.4	5.9	0.5	6.03	....	....
l. gambeli O.	♂ adult	10	6.3	5.8	0.5	6.02	....	....
l. gambeli O.	♀ adult	9	6.6	5.7	0.9	6.01	....	....
l. gambeli S.	♂ adult	8	6.5	6.0	0.5	6.06	....	....
l. gambeli S.	♀ adult	10	6.1	5.6	0.5	5.79	....	....
l. gambeli S.F.	♂ adult	20	6.6	5.8	0.8	6.19±0.05	0.30±0.03	4.84±0.51
l. gambeli S.F.	♀ adult	15	6.6	5.6	1.0	6.17±0.05	0.31±0.04	5.02±0.61
l. gambeli L.A.	♂ adult	25	6.6	5.7	0.9	6.17±0.03	0.25±0.02	4.05±0.38
l. gambeli L.A.	♀ adult	23	6.4	5.6	0.8	6.07±0.03	0.22±0.02	3.68±0.37
l. anthonyi	♂ adult	14	6.4	5.8	0.6	6.14±0.03	0.15±0.02	2.44±0.31
l. anthonyi	♀ adult	6	6.5	5.9	0.6	6.21	....	....
l. mearnsi	♂ adult	5	6.6	6.1	0.5	6.26	....	....

the correlations of which are uncertain, these characters probably being associated with small differences of behavior connected with feeding, or in the case of the feet possibly with the type of floral environment or with the general size or bulk. In other words, known external structural variation is chiefly (1) an increase or decrease in pigmentation associated with climate, (2) adaptive modifications of

flying power, and (3) modifications of bill and feet possibly in response to various perching or feeding activities.

Characters which may be considered palingenetic are few, but in this category might be placed vermiculations, white spots on the rectrices,

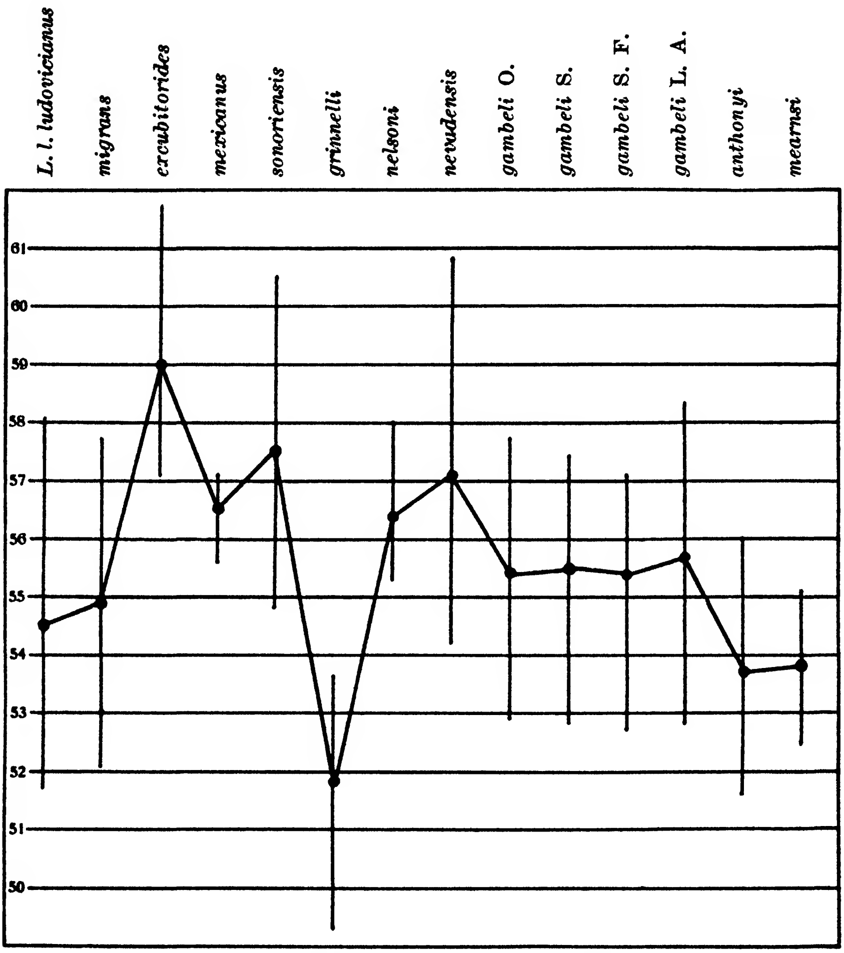

Fig. 36. Diagram showing individual and geographic variation in amount of white on primaries of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages. Figures indicate extent of white area expressed in per cent of wing length.

and the color of the rump. Although these three characters, especially the first two, make possible a grouping of the subspecies into two natural divisions, I see no possibility of deciding which division should be considered as the more primitive. It seems futile, therefore, to attempt to outline a phylogeny among a group of races which show

chiefly the influence of their present environment and which possess few and uncertain palingenetic features. Schiebel in his phylogeny of shrikes (1906, p. 74–76) has arranged the races of *L. ludovicianus* known at the time of his writing in the following phylogenetic order,

TABLE 21

GEOGRAPHIC VARIATION IN AMOUNT OF WHITE ON PRIMARIES

Figures represent per cent of total primary length

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent of mean)
e. borealis	♂ adult	3	55.6	52.1	3.5	53 96	....	....
e. borealis	♂ first-year	16	54.3	51.9	2.4	52.91±0.16	0.96±0.11	1.81±0.21
e. borealis	♀ adult	6	55.7	52.2	3 5	53 85	....	....
e. borealis	♀ first-year	8	53.3	49.2	4 2	51 06	....	....
e. invictus	♂ adult	12	59.4	53.8	5.6	55 40	....	....
e. invictus	♂ first-year	27	57.0	51 2	5.8	54.31±0.27	2.11±0.19	3.88±0.35
e. invictus	♀ adult	4	56.1	51.8	4.3	53 47	....	....
e. invictus	♀ first-year	17	56.2	51.3	4.9	53.38±0.29	1.79±0.20	3.35±0.38
l. ludovicianus	♂ adult	44	58.1	51 7	6.4	54.58±0.17	1.75±0.13	3.20±0 24
l. ludovicianus	♀ adult	31	57.4	50.9	6.5	53.86±0.19	1.57±0.13	2.04±0.17
l. migrans	♂ adult	18	57.7	52.1	5.6	54.93±0.27	1.73±0.19	3.14±0.35
l. migrans	♀ adult	15	56 5	51.8	4 7	54.61±0 23	1.33±0 16	2.43±0.29
l. excubitorides	♂ adult	12	61.7	57.1	4.6	59.01±0 25	1.31±0.18	2.21±0.30
l. excubitorides	♀ adult	7	59.5	54.0	5.5	57.34	....	....
l. mexicanus	♂ adult	6	57.1	55.6	1.5	56 55	....	....
l. mexicanus	♀ adult	4	58 3	56.6	1.7	57.42	....	....
l. sonoriensis	♂ adult	37	60.5	54.8	5.7	57.56±0.16	1.51±0.11	2 62±0 20
l. sonoriensis	♀ adult	26	60.6	53.8	6.8	56.65±0.28	2.13±0.19	3.75±0.35
l. grinnelli	♂ adult	7	53 6	49 3	4.2	51.87	....	....
l. nelsoni	♂ adult	5	58.0	55.3	2.7	56.40	....	....
l. nelsoni	♀ adult	7	56.5	53.5	3.0	54.88	....	....
l. nevadensis	♂ adult	26	60.8	54.2	6.6	57.13±0 25	1.95±0.18	3.41±0 31
l. nevadensis	♀ adult	14	60.0	53.7	6.3	56.33	....	....
l. gambeli O.	♂ adult	9	57.7	52.9	4 8	55.41	....	....
l. gambeli O.	♀ adult	8	56.4	52 5	3.9	54 74	....	....
l. gambeli S.	♂ adult	8	57.4	52.8	4.6	55 11	....	....
l. gambeli S.	♀ adult	10	59.3	54.5	4.8	57.90	....	....
l. gambeli S.F.	♂ adult	20	57.1	52.7	4.4	55.37±0.20	1.38±0.14	2.49±0.26
l. gambeli S.F.	♀ adult	14	58.0	53.3	4.7	55.93±0 25	1.43±0.18	2.55±0.32
l. gambeli L.A.	♂ adult	24	58.3	52.8	5.5	55.73±0.21	1.56±0.15	2.79±0.27
l. gambeli L.A.	♀ adult	22	57.7	53.8	4.9	55.80±0.18	1.28±0.13	2.29±0.23
l. anthonyi	♂ adult	13	56.0	51.6	4.4	53.76±0.26	1.39±0.18	2.58±0.34
l. anthonyi	♀ adult	6	55.4	52.5	2.9	53.56	....	....
l. mearnsi	♂ adult	5	55.1	52.5	2.6	53.88	....	....

starting with the most primitive: *anthonyi, gambeli, migrans, L. l. ludovicianus, excubitorides,* and *mexicanus.* His principal basis for this arrangement appears to be the color of the under parts, particularly the vermiculations. Apparently he has failed to consider the association of humid climate with dark coloration. As regards the vermiculations and brownish coloration seen in the western races and

best shown in *gambeli,* not *anthonyi,* these characters do appear to indicate a primitive condition. At least this is true if we consider the adult vermiculated types of some of the Old World species as the most primitive, a justifiable premise. I can agree with Streets

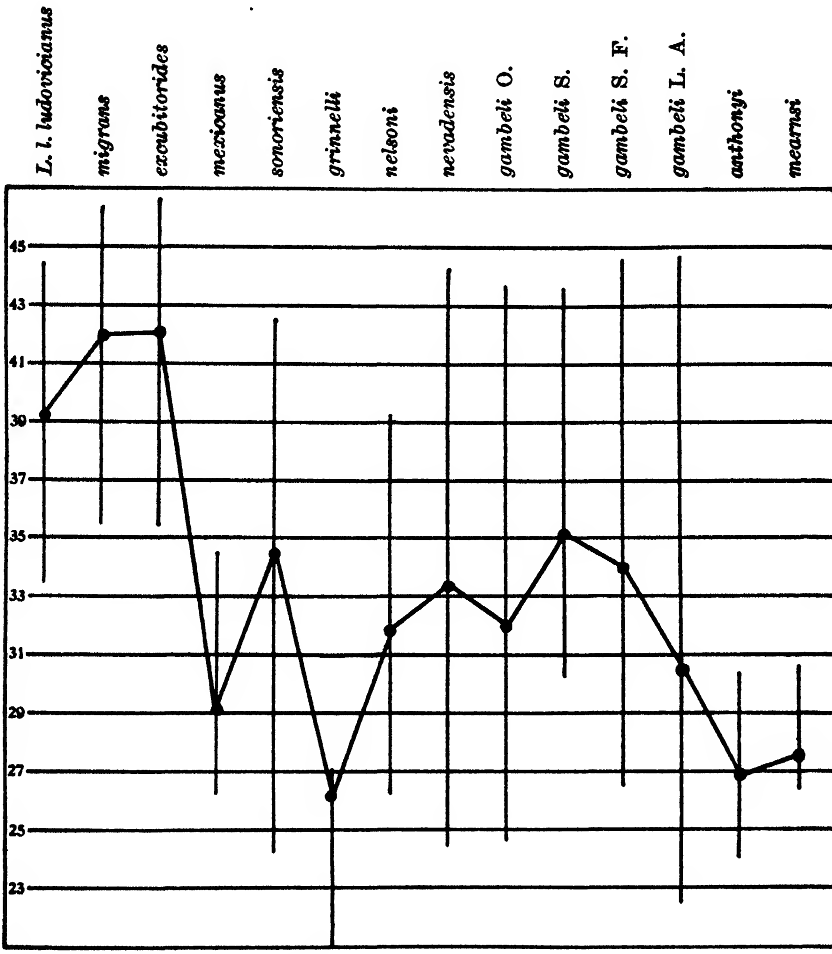

Fig. 37. Diagram showing individual and geographic variation in amount of white on outer rectrix of adult males of fourteen geographic groups. Length of lines shows range of individual variation; points connected by lines mark positions of averages. Figures indicate extent of white tipping expressed in per cent of tail length.

(1883) and with Schiebel that *borealis* and *invictus* are more primitive than *L. ludovicianus* in their retention of the juvenal type of breast vermiculation. This does not indicate, however, that the species *L. ludovicianus* originated from *borealis* stock. The difference between the American *L. excubitor* and *L. ludovicianus* are too great to sup-

pose any recent derivation of one from the other. Since the time that *L. ludovicianus* became separated as an American group, from what I believe was probably some small *excubitor* type from temperate Europe or Asia, the ever recurrent tendency for the appearance of vermiculations within the genus could have experienced in *L. ludo-*

TABLE 22

GEOGRAPHIC VARIATION IN AMOUNT OF WHITE ON OUTERMOST RECTRIX

Figures represent per cent of total tail length

Geographic group	Sex and age	Number of specimens	Maximum	Minimum	Range	Mean	Standard deviation	Coefficient of variability (per cent of mean)
e. borealis	♂ adult	3	33 5	31 6	1 9	32 70		
e. borealis	♂ first-year	21	44 4	25 9	18 5	32 65±0 81	5 55±0 57	16 99±1 70
e. borealis	♀ adult	6	36 4	26 4	10 0	30 86		
e. borealis	♀ first-year	22	31 3	21 9	9 4	25 58±0 37	2 64±0 26	10 32±1 40
e. invictus	♂ adult	11	47 8	34 4	13 4	42 40±0 78	3 83±0 55	9 03±1 20
e. invictus	♂ first-year	27	48 0	30 3	17 7	36 95±0 69	5 34±0 49	14 45±1 30
e. invictus	♀ adult	5	42 7	31 2	11 5	35 28		
e. invictus	♀ first-year	30	40 1	26 2	13 9	32 17±0 53	3 80±0 38	11 81±1 00
l. ludovicianus	♂ adult	43	44 4	33 5	10 9	39 27±0 36	3 54±0 25	9 01±0 65
l. ludovicianus	♀ adult	30	44 5	30 0	14 5	37 69±0 52	4 16±0 36	11 03±0 96
l. migrans	♂ adult	17	46 3	35 6	10 7	42 03±0 77	4 71±0 54	11 20±1 29
l. migrans	♀ adult	15	46 5	29 3	17 2	37 77±1 00	5 76±0 71	15 25±1 88
l. excubitorides	♂ adult	10	46 5	35 5	11 0	42 10±0 85	4 02±0 60	9 54±1 40
l. excubitorides	♀ adult	5	48 3	40 4	7 9	44 76		
l. mexicanus	♂ adult	6	34 5	26 2	8 3	29 10		
l. sonoriensis	♂ adult	32	42 6	24 2	28 4	34 55±0 66	5 54±0 46	16 04±1 35
l. sonoriensis	♀ adult	26	43 5	23 6	19 9	30 47±0 56	4 25±0 39	13 94±1 31
l. grinnelli	♂ adult	7	27 1	21 0	6 1	26 18		
l. nelsoni	♂ adult	6	39 2	26 2	17 0	31 78		
l. nelsoni	♀ adult	8	33 8	24 2	9 6	31 41		
l. nevadensis	♂ adult	24	44 2	24 4	19 8	33 30±0 98	6 10±0 59	18 31±1 70
l. nevadensis	♀ adult	15	38 0	21 3	16 7	28 24		
l. gambeli O.	♂ adult	10	43 6	24 8	18 8	32 02		
l. gambeli O.	♀ adult	8	36 3	22 5	13 8	30 36		
l. gambeli S.	♂ adult	8	43 5	30 3	13 2	35 12		
l. gambeli S	♀ adult	10	44 7	26 4	18 3	33 92		
l. gambeli S.F.	♂ adult	19	44 5	26 4	18 2	33 90±0 81	5 23±0 57	15 42±1 68
l. gambeli S.F.	♀ adult	14	37 3	24 0	13 3	31 90±0 84	4 67±0 59	14 63±1 87
l. gambeli L.A.	♂ adult	22	44 6	22 5	22 1	30 52±0 83	5 80±0 59	19 00±1 93
l gambeli L.A	♀ adult	19	44 6	22 9	21 7	29.94±1 08	6 98±0 76	23 30±2 55
l. anthonyi	♂ adult	13	30 3	24 0	6 3	26 93±0 39	2 13±0 28	7 90±1 00
l. anthonyi	♀ adult	5	32 6	25 7	6 9	29 24		
l. mearnsi	♂ adult	5	30 7	26 4	4 3	28 14		

vicianus numerous modifications, vermiculations perhaps disappearing and again reappearing in response to climatic influences. As Salomonsen (1928, p. 195) has pointed out, *L. ludovicianus* was probably in North America before the Pleistocene ice periods and became isolated and subsequently locally modified previous to or during the Pleistocene. *L. e. borealis* and *L. e. invictus* represent a separate in-

vasion from Asia retaining subspecific relations today with Old World forms because of their more recent arrival, or, as I think might be true, because of a lack of sufficiently effective habitat or physical barrier between *invictus* and *L. e. mollis* of Siberia; this lack of barrier would prevent complete isolation and an eventual specific divergence. The only record of fossil North American shrikes is that of the species *L. ludovicianus* in the middle or late Pleistocene of Rancho La Brea (A. H. Miller, 1929, p. 12, pl. 1).

Returning to the problem of the differentiation of geographic races in *L. ludovicianus*, it has been pointed out that these races reflect average differences in habitat obtaining over comparatively large areas; these races do not show the effect of local conditions to the degree that do species of less wide-ranging habits and more restricted ecological preferences. It has been said that some bird species are more plastic than others. This may be true. But, is this apparent plasticity involving the formation of subspecies on the part of a bird due so much to an inherent plasticity of genetic composition as to a lack of individual plasticity, that is to say, close dependence on some narrowly defined ecological niche, which, therefore, requires the species to change in response to all minor differences in habitat whether or not it is especially plastic genetically?

Among the eleven races of *L. ludovicianus* there are noticeable differences with regard to the magnitude of the subspecific differentiation and the rapidity spatially with which one race intergrades into the adjacent race or races. There seem to me to be three important factors governing these differences in the magnitude of the subspecific differentiation of Loggerhead Shrikes: first, the degree of difference of the environment compared with the environments of other adjacent races; second, the effectiveness of barriers to isolate the area occupied by the race; and, third, the migration or lack of migration both as concerns any particular race in question and neighboring races which might invade its range during the winter season. The width of the zone of intergradation between subspecies depends somewhat on the intensity of the differences in environment but more particularly depends on whether or not environmental changes are sudden, or are gradual over a broad territorial interval. Intergradation is influenced further by the presence or absence of barriers, and, again, by migration.

Barriers to Loggerhead Shrikes are of chiefly the faunal and associational categories (see Grinnell, 1914, p. 109), except for the

island and peninsular races which are well surrounded by the physical barrier of the ocean. Dense forests and precipitous mountains are the principal associational barriers since these regions do not provide shrikes with suitable territory in which to feed. Zonal or temperature barriers appear to have little effect in limiting the distribution of shrikes. In colder climates it is believed that it is the snow cover rather than the low temperature that governs the presence or absence of *L. ludovicianus.* Nevertheless, mountains and dense forests occasionally may be crossed. In the collection of the Museum of Vertebrate Zoology of the University of California there is an immature *nevadensis,* no. 20647, taken at an elevation of 9800 feet at Whitney Meadow in the Sierra Nevada, California, on August 8, 1911.

Turning to examples of differences in degree of differentiation and intergradation of subspecies, it may be seen that the races *migrans* and *excubitorides* in their extreme forms are well differentiated as a result of a marked contrast between the arid habitat of the Great Plains and the partly timbered, more humid habitat along the eastern coast. The intergradation between the two, however, is the most gradual of any of the intergrading zones within the species. This seems to be due to the gradual transition in environment, lack of a sharp barrier, and the fact that both races migrate and may mingle during the winter months. This latter would provide more chance for the two populations to mix than if one or both of them were constantly resident.

Between the races *migrans* and *L. l. ludovicianus* there is no greater contrast than between *migrans* and *excubitorides,* yet the intergradation is much more abrupt. This may be interpreted as due to partial isolation brought about by the more effective associational barrier formed by the forests and mountainous areas of the Alleghany region and also to a sharper transition from one environment to the other.

L. l. ludovicianus does not intergrade directly with *excubitorides* because of a wide faunal barrier or uninhabited zone during the breeding season along the Gulf coast east of the Mississippi River, the nature of which is not understood in relation to the breeding of shrikes.

Intergradation between *gambeli* and *excubitorides* in Montana and between *nevadensis* and *excubitorides* in Colorado is moderately abrupt because of a mountain and forest barrier even though this be of an intermittent type. All three of these races, however, are migratory in the regions mentioned, and, correspondingly, intergradation is less

abrupt than might be expected were they completely resident. These three races often mingle on the wintering grounds in Mexico. Between *sonoriensis* and *excubitorides* the belt of intergradation is fairly narrow, perhaps more so than between *nevadensis* and *excubitorides*. This would appear to be due to the fact that where *excubitorides* meets *sonoriensis* both races are resident. An appreciable barrier is lacking between the two. Where *excubitorides* merges with *mexicanus,* so far as this region of intergradation is known, there is a lack of sharp barrier and no abrupt change of habitat; *excubitorides* winters within the breeding range of *mexicanus*. The intergrading zone, consequently, is comparatively broad occupying a large part of the state of Tamaulipas.

One of the most distinct and abrupt contrasts between races, other than the separation of the island forms, is found between *sonoriensis* and *grinnelli*. Several factors contribute to this contrast. The habitats of the two are decidedly different and the change is sudden from one habitat to the other. Furthermore, there is a partial mountain barrier, and both races are entirely resident.

Intergradation between *gambeli* and the races to the east, *nevadensis* and *sonoriensis*, is of interest, for different conditions prevail at the several points where intergradation takes place. In the north, the east and west boundary between *gambeli* and *nevadensis* is poorly defined. Both races are here migratory and are not separated by abrupt environmental changes or by barriers. In southern California, however, particularly in northern Los Angeles County, the intergradation is less gradual. In this vicinity, there is an incomplete mountain barrier as well as a rapid transition between habitats. Still farther south, in Riverside County, California, the intergradation between *gambeli* and *sonoriensis* is even more abrupt. These two races at this point are non-migratory, separated by incomplete mountain barriers, with habitats even more sharply contrasted than are the habitats of *gambeli* and *nevadensis* in Los Angeles County. I am unable to concur with Bishop (1927, p. 78) that there is no intergradation between the birds of the eastern deserts and *gambeli* of the coast in southern California. It is true that intergradation occurs at but few points in southern California because of the mountain barriers. A few breeding birds from the vicinity of Whitewater and Cabezon I am forced to consider as intergrades between *sonoriensis* and *gambeli,* contrary to Bishop's statement (pp. 78, 79) that a hiatus between the two races exists at this point. Likewise, intergrades have been taken at several points

in eastern San Diego County. Field studies and collections made by me in July, 1928, in the zones of intergradation between *gambeli* and *nevadensis* in Kern and Los Angeles counties have shown the normal type of racial intergradation in these regions.

Intergradation between *gambeli* and *grinnelli,* and between *grinnelli* and *nelsoni* on the Lower California peninsula is not accompanied by pronounced barriers and the transition from one habitat to another is gradual. However, the area which has differentiated *grinnelli* appears to be particularly potent in producing well marked subspecies, and this combined with the complete residence of these races seems to have prevented the intergrading areas from becoming as extensive as are the zones between *mexicanus* and *excubitorides* and between *excubitorides* and *migrans.*

The two island races, almost completely isolated from the mainland races by a physical barrier, might be expected to lack structural intergradation with *gambeli* and, thus, to become recognizable as full species. Perhaps there has not been time for this to be accomplished, but more likely, the differences in the environments on the islands and on the mainland have not been sufficient to bring about or allow a modification of a magnitude to prevent an overlapping of characters in the birds of these two areas. Thus, although *anthonyi* and *gambeli* in southern California are almost completely resident and separated by a water barrier, yet some intergradation of the non-geographical sort occurs because of a lack of a sufficiently abrupt contrast in environments (see p. 82). *Mearnsi* has progressed farther than *anthonyi* and does not intergrade with mainland forms. Its sole connection with the remainder of the species is through *anthonyi,* here again overlapping occurring only because of an insufficient contrast between environments on Santa Catalina and San Clemente islands.

NATURAL HISTORY

MOLT

PTERYLOGRAPHY

In a study of molt in the Loggerhead Shrike (A. H. Miller, 1928) a description of the pterylography of the wing of this species was presented. It seems desirable to figure fully the entire pterylography of this species at the present time as a foundation for the additional discussions of molt which are included here. The figures and descrip-

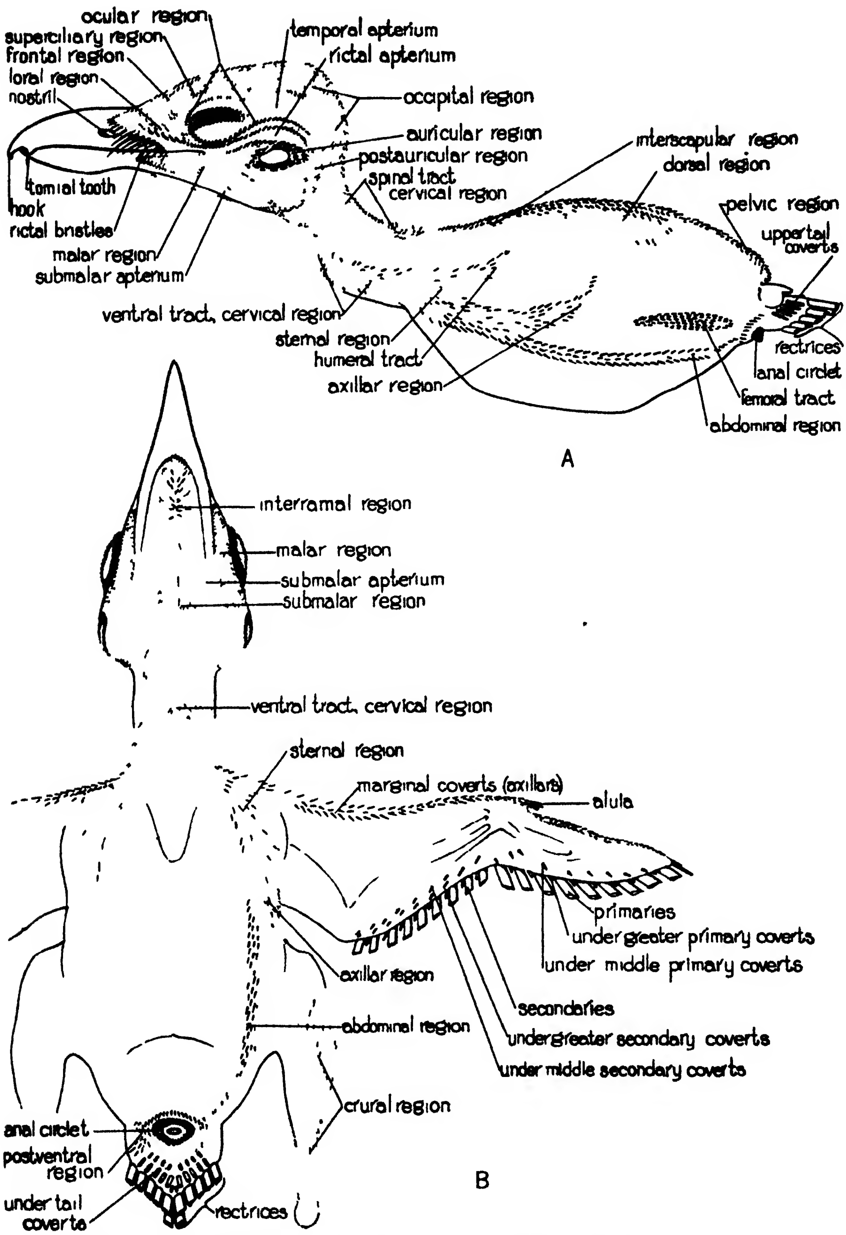

Fig. 38. Pterylography of *Lanius ludovicianus gambeli*; A, lateral view, natural size; B, ventral view, natural size.

tions relating to pterylography are based on a study of clipped alcoholic specimens of *gambeli* and *sonoriensis* together with examinations of living *gambeli* and study skins of all the races of *L. ludovicianus* and *L. excubitor*. Preserved specimens of *excubitor* have not been available. As far as can be learned, the two American species are similar; certainly this is true of the wing feathers.

According to Nitzsch (1840, p. 72) there is great uniformity among the Passeriformes in the arrangement of the feather tracts. The variations that occur in this Order have to do largely with form and relative magnitude of the tracts and not with any fundamental departure from type, such as the presence or absence of entire tracts or regions. The nomenclature here employed conforms with that used by Boulton (1927) and Burt (1929). Comparisons with other passerines will not be attempted, the figures here presented serving to show differences should these be compared with figures of pterylography in other birds.

Capital tract.—The frontal region (forehead) is densely feathered, without definite arrangement in rows, and surrounds a distinct frontal apterium overlying the ridged maxillary region posterior to the horn-covered culmen. The appearance of this small apterium is to be associated with the elevation of the maxillaries and nasals into a median crest coincident with the production of a raptorial bill. Burt (1929, p. 434) remarks that comparable small apteria appearing over hard bony structures, such as the hyoids of woodpeckers, perhaps are due to an increase in pressure on the skin from beneath. The feathers at the anterior margin of the frontal region are directed forward, but the feathers of the remainder of the region are directed postero-laterally. At the margins of the frontal apterium the feathers are directed mediad. The coronal (crown) and occipital (occiput) regions are densely feathered medially, especially along the groove in the interorbital region. Laterally and in the posterior occipital region the feathering is distinctly sparser. The feathers of these two regions while directed posteriorly in the middle line become progressively more lateral in their direction toward the sides of the head. They are at no time arranged in distinct rows. The superciliary region is not distinct from the lateral parts of the coronal region but may be defined as the two rows of feathers at the dorsal margin of the ocular apterium which produce the white or gray superciliary line of the plumage; the inner of the two rows is usually irregular. The loral region is similar in its manner of feathering to the frontal region and merges with it. The single row of rictal bristles is well developed and

may reach a length of about eleven millimeters. The ocular region consists of the following: a distinct row of small feathers extending from the anterior corner of the eye posteriorly across the base of the upper eyelid to fuse with the posterior end of the superciliary region;

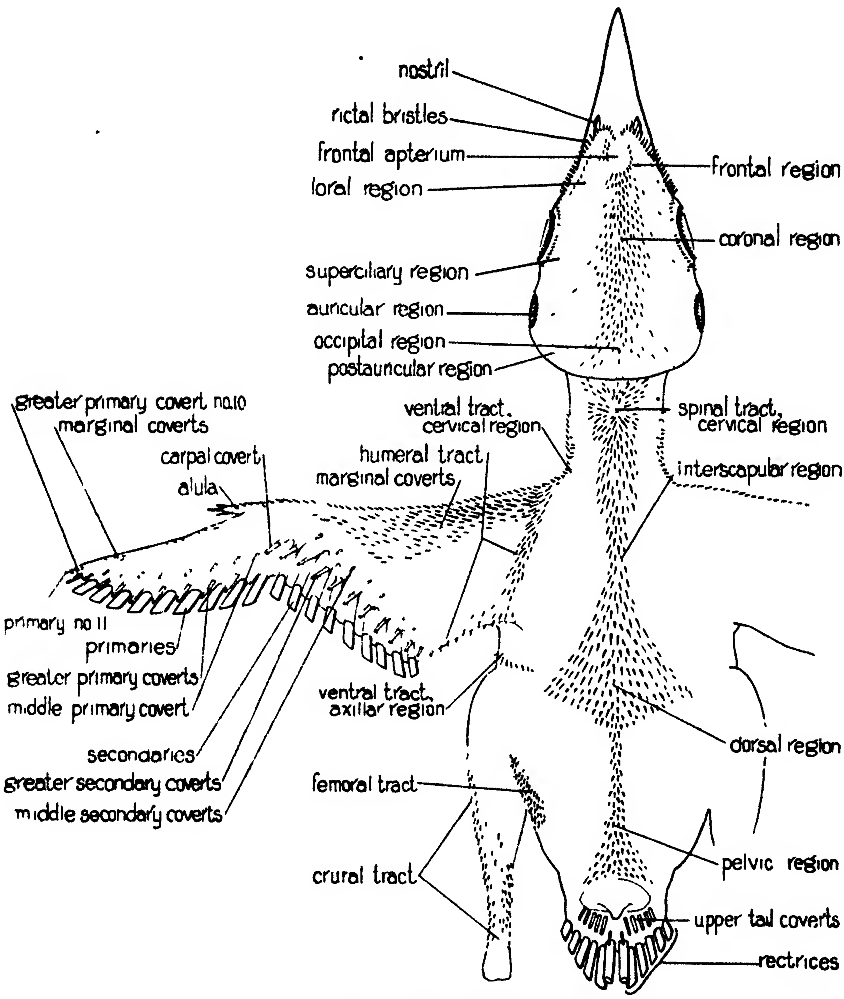

Fig. 39. Pterylography of *Lanius ludovicianus gambeli*, dorsal view, natural size.

the small feathers at the inner margins of the eyelids; and, two distinct rows of moderately large feathers, one row beginning at the anterior corner of the eye, the other a continuation of the lowest row of the loral region, which course posteriorly and curve dorsally over the auricular region. These latter rows are separated from the auricular and malar regions by the rictal apterium and from the temporal

and posterior coronal regions by the temporal apterium. The malar region, occupying the side of the lower mandible, is confluent with the submalar region of the ventral tract and with the postauricular region at the posterior angle of the lower mandible; the feathers of this region are arranged in irregular rows, all directed posteriorly except along the margins and at the anterior end where a whorl of feathers occurs. Anteriorly, the malar region is separated from the submalar and interramal regions of the ventral tract by the submalar apterium. The auditory opening is surrounded by three or four rows of large, loose-vaned feathers, similar to those of the adjacent ocular region, all of which are directed posteriorly. The small postauricular region is composed of small feathers sparsely distributed, being merely a lateral extension of the occipital region.

Spinal tract.—In the broad cervical region (hind neck) shortly posterior to its junction with the occipital region, there is a whorl from which the feathers radiate in all directions. Posterior to this point the feathers in the spinal tract are directed posteriorly and at the margins posterolaterally. Passing backward, the cervical region gradually narrows and merges into the interscapular region which may be only three or four feathers in width. The dorsal region is greatly broadened into an irregular rhombic area. Continuing posteriorly is the narrow anterior pelvic region (upper rump) consisting of a strip, but two or three feathers in width, which broadens into the posterior pelvic region (lower rump), ending anterior to the oil gland with the exception of a few small feathers which encircle the sides of the gland.

Caudal tract.—Posterior to the oil gland and overlying the bases of the rectrices are twelve upper tail coverts symmetrically arranged, six on each side of the middle line. The central pair is smaller than the others and is placed farther posteriorly. The twelve rectrices are of nearly equal size basally, the middle pair being inserted nearly dorsal to the adjacent pair. The twelve under tail coverts are arranged in a manner comparable to the placement of the upper tail coverts. The anal circlet consists of a single close-set row of feathers which project at right angles to the surface of the margin of the vent. Between the anal circlet and the under tail coverts is a group of about eight feathers which might be termed lesser under tail coverts in contrast to the principal row of greater under tail coverts immediately anterior to the rectrices. The postventral region consists of small, irregularly placed feathers posterolateral to the anal circlet.

Ventral tract.—The center of the malar region (chin) coincides with the center of a whorl of feathers, which spreads over the entire region. Some of the feathers of this area, as well as feathers in the loral and frontal regions, possess bristle-like tips. The broad submalar region (throat) is continuous with the cervical region (upper breast) which divides medially to give off the sternal region (breast and sides). The feathers of these regions at the margins are directed either laterally or medially covering the extensive apteria adjoining them. The cervical region is also continuous with the marginal coverts of the alar tract. The broad sternal region divides anterior to the knee into an axillar region (sides) and an abdominal region. The axillar region turns dorsally and narrows to a single row of feathers which nearly meets the dorsal region of the spinal tract. The abdominal region is about three feathers in width as far posteriorly as the posterior end of the sternum where it narrows into a single line of feathers, which curves medially and joins with its counterpart of the opposite side at a point just anterior to the anal circlet.

Alar tract.—The following regions are included: primaries, ten (plus one vestigial primary); greater primary upper coverts, ten; middle primary upper coverts; marginal coverts of the hand; alula; alula coverts; secondaries, nine; greater secondary upper coverts, ten; middle secondary upper coverts, nine; marginal coverts of the arm, the posteroventral margin of which forms the group of feathers termed axillars; greater primary under coverts; middle (or lesser) primary under coverts; greater (or middle) secondary under coverts; middle (or lesser) secondary under coverts, carpometacarpal coverts.

For the arrangement and location of these regions see figures 38 and 39 and the discussion of wing pterylography (A. H. Miller, 1928, pp. 397–399).

Humeral tract.—This tract is composed of two parts, a broad region (scapulars) running backward from the anterior margin of the wing along the junction of the wing and body, and a group of small feathers along the posterior edge of the humeral segment of the wing, the humeral coverts of Reichling (1915, p. 239).

Femoral tract.—The feathers of this tract are set close together forming an extremely compact tuft on the posterolateral margin of the body above the leg.

Crural tract.—This tract is sparsely feathered proximally but becomes more densely feathered near its distal margin at the heel. No distinct separation into external and internal divisions is to be noted.

Down feathers or plumulae do not occur in the pterylae but are found in most of the apteria. Some of the more prominent down feathers are represented in the figures as extremely small scattered dots. Filoplumes are common in the feather tracts.

The present discussion supplements the previous description I have given of molt (*loc. cit.*) through the addition of data pertaining to *L. excubitor*, but chiefly, by a further analysis of racial differences in the degree of completeness of the first fall molt.

FIRST FALL MOLT

L. ludovicianus.—The initial stage in this molt is the appearance of new marginal wing coverts near the junction of wing and body. These replace a few juvenal feathers formerly in this region, but, to a large degree, the new coverts grow in areas where feathers were lacking previously. The new coverts might be considered as a late appearance of part of the juvenal plumage, were it not for the fact that they are similar in color and texture to feathers of adults and are retained throughout the first year. Their first appearance usually occurs at about the time when the parents cease feeding the young. Thus, the beginning of the molt seems to be determined by the date at which the young are hatched. Birds hatched early in the spring complete the first stages of the molt earlier than birds hatched late in the spring. It does not follow, however, that the succeeding and final stages of the molt are affected by the date of hatching. After the appearance of new marginal wing coverts, there usually follows a period, which I believe to be of varying length depending somewhat upon the advance of the season, when only the forehead shows signs of molt, the remainder of the body and wings retaining full juvenal plumage. Such a period has been observed in cage birds, where it was seen to vary in length, and also is indicated in a series of skins of molting juveniles. The later stages of the molt within any one race or population depend largely upon the vigor of the individual as regards the rapidity and completeness with which they proceed. The time occupied in molting is between three and four months for any one individual, usually three and one-half months. For a population taken as a whole the total length of the period in which molt may be encountered depends on the length of the breeding season and of the summer season which follows. Members of a population that arrive on

the breeding ground late in the spring and leave early in the fall, undergo the principal stages of the molt almost simultaneously, and the molt period for the population or race as a result is short. For example, *migrans* accomplishes the first fall molt chiefly in July, August, and September, whereas, individuals of the resident forms *grinnelli* and *nelsoni* may be found molting any time between April and November. It is possible that in *grinnelli* and *nelsoni* the length of the molt period of each individual also is long. As would be expected, more complete molts require a relatively long period of time. Therefore, southern latitudes and geographic areas where seasons are not sharply defined do not hold the shrikes to a rigid molting schedule and in some cases permit of extensive first fall replacements.

The molt is not necessarily entirely complete before migration takes place. Part of the body plumage and part of the tail, in some instances, are replaced after arrival on the wintering grounds. A few rare instances of molting primaries occurring during or after migration have been seen in fall specimens of *excubitorides* taken in southern Mexico.

The following table illustrates the sequence of feather replacement and the approximate time involved in the molt of the various regions of the body as determined for *gambeli*.

TABLE 23

PERIODS OF THE FIRST FALL MOLT

Lanius ludovicianus gambeli

Period of molt	Number of specimens	Total extent	Mean
No molt yet in evidence	9	Up to June 23	
Marginal coverts only	22	April 24 to August 8	June 20
Upper middle coverts, but not greater coverts	19	June 19 to September 21	August 2
Body	25	July 17 to October 2	August 26
Upper greater secondary coverts	5	August 8 to September 22	September 2
Tail	16	September 6 to October 14	September 16
Primary	12	September 6 to October 14	September 16
Inner Secondary	13	September 6 to November 27	October 3

L. excubitor.—The first fall molt in the American members of this species is similar to that of *L. ludovicianus* as regards the order of replacement of feathers so far as can be learned from the few specimens available which exhibit this molt. However, *excubitor* differs widely from *L. ludovicianus* in the completeness of the molt. It would appear that the process is more rapid than in *L. ludovicianus* since

juveniles still with incompletely grown juvenal tails begin the molt of the marginal coverts of the arm. The first fall molt never extends to the primaries, alula, or greater primary upper coverts, and rarely to the innermost secondaries. Part, all, or none of the greater secondary upper coverts are replaced and some individuals fail to molt the middle upper coverts of the wing and the upper tail coverts. The rectrices are never replaced except in cases of accidental loss of the juvenal feathers. The molt appears to occupy little more than two months, July and August, the process being complete in September except for scattered body feathers.

MIXTURE OF JUVENAL WITH FIRST-YEAR FEATHERS IN THE FIRST-YEAR PLUMAGE

In order to compare statistically the degree of mixture of juvenal and first-year feathers, a tabulation was made of the condition of all skins of first-year shrikes having completed the fall molt. The information thus gained was compiled in the form of diagrams and graphs presented herewith. The principal feather regions which are variable in this regard are: primaries, secondaries, greater secondary upper coverts, and rectrices. Less important regions of variation, such as the occasional retention of juvenal middle wing coverts and tail coverts in *excubitor* and the partial replacement of greater primary coverts in *grinnelli*, have not been considered statistically. The geographic groupings used in making comparisons correspond to the thirteen subspecies of *L. excubitor* and *L. ludovicianus* plus the subdivisions of *gambeli, excubitorides,* and *migrans* into smaller groups according to variations in the migratory habit (see fig. 40).

Primaries.—The number of first-year birds in a population which fail to molt any of the juvenal primaries varies from 15 to 100 per cent. When primaries are replaced, the number involved is usually more than one as shown in the diagrams in figures 42 and 43. In figure 41 it may be seen that the average number of primaries replaced is influenced by the migration of a population and by the length of the summer and breeding seasons. *Migrans* replaces fewer primaries than *L. l. ludovicianus* and the northern population of *migrans* replaces fewer than the southern population of the same race. Similar contrasts may be seen in the northern and southern groups of *excubitorides.* Nevertheless, aside from the effect of latitude, migration, and season on the replacement of primaries, additional differ-

ences in replacement are to be noted, for the northern *excubitorides* and northern *migrans* groups are not alike in this regard. Neither are resident races from the same latitude always similar in the degree of replacement as may be seen by comparing *L. l. ludovicianus* with *sonoriensis*. It may be concluded, therefore, that there are pronounced subspecific as well as specific differences in the matter of

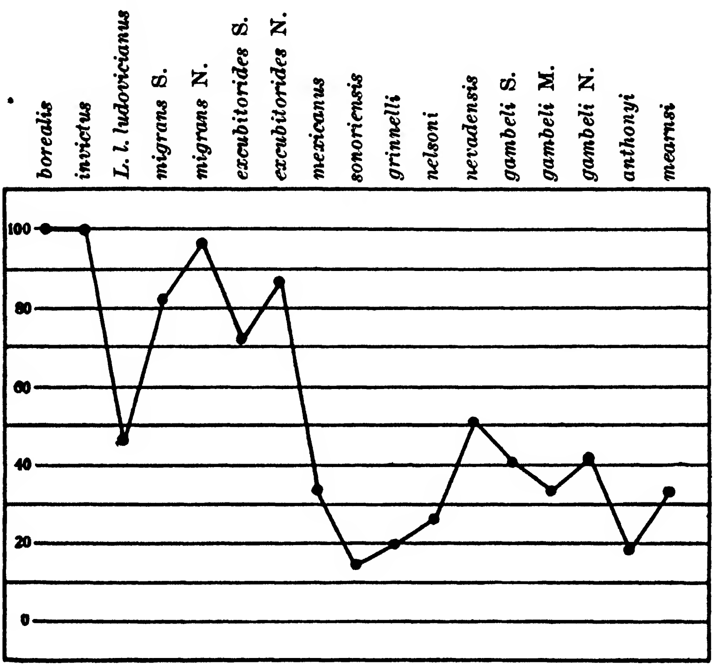

Fig. 40. Geographic variation in per cent of first-year population retaining all juvenal primaries throughout the first year. *Migrans* S., birds breeding in Kansas, Missouri, Illinois, Indiana, Ohio, and Pennsylvania and in regions to the south; *migrans* N, birds breeding north of these states. *Excubitorides* S., birds breeding in Colorado and Kansas and regions to the south; *excubitorides* N., birds breeding to the north of these states. *Gambeli* S., birds permanently resident in southern California; *gambeli* M., birds breeding in the San Joaquin and Sacramento valleys and in the San Francisco Bay region of California; *gambeli* N., birds breeding in extreme northern California, Oregon, Washington, Idaho, Montana, and Canada.

primary replacement, which are not the immediate result of migration or latitude upon the individual. In other words, there appear to be inherent average tendencies in some subspecies to undergo a more complete primary molt than that occurring in other races. These supposed heritable tendencies correspond to subspecific variation in purely structural features. Probably these subspecific differences in molt have arisen as adjustments to environments but it appears that these adjustments are race wide, that is, characteristic of the entire group

although within wide limits of individual variability. Racial differences in the molt of the primaries tend to divide the subspecies of *L. ludovicianus* into two groups, an eastern division and a western division, corresponding to a similar division made possible on the basis of varying amounts of white on the rectrices and the appearance of vermiculations on the breast. *Migrans, excubitorides,* and *L. l. ludovicianus* (low in replacement considering its non-migratory

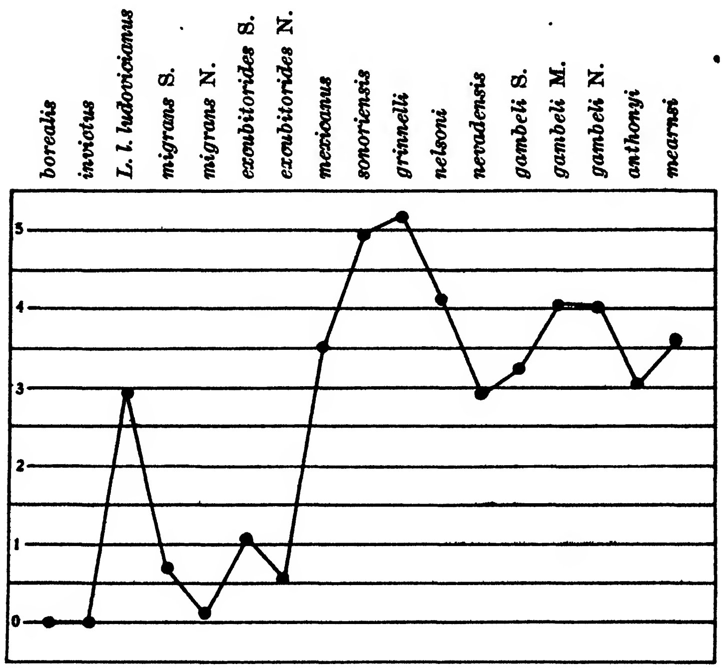

Fig. 41. Geographic variation in number of primaries replaced during first fall molt. Dots mark average number of primaries replaced in each group. For explanation of geographic groups see figure 40.

habit) constitute the eastern group of *L. ludovicianus* in contrast with all the other races of the species, which latter tend to replace relatively greater numbers of primaries even though migratory in habit.

Secondaries.—The replacement of secondaries is much more uniform than the replacement of primaries and indicates no certain subspecific differences. The high replacement indicated for *grinnelli* possibly is significant but probably is the result in part of the small number of first-year specimens of this race available for study. Variation in secondary replacement shows no correlation with primary replacement. It is believed that the lesser importance of the inner secondaries in flight partly accounts for this lack of variation in their

molt. One of the functions of the innermost secondaries is the protection and covering of the dorsolateral body surface. The need of this protection and the wearing away of the feathers which provide it would appear to be fairly constant within the species. Perhaps,

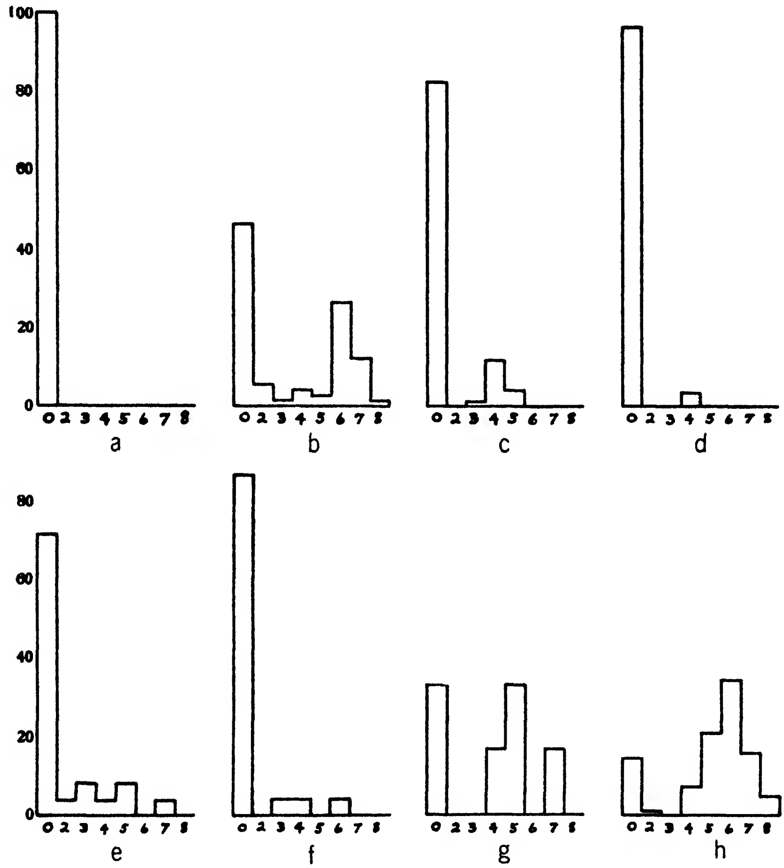

Fig. 42. Geographic variation in number of primaries replaced at first fall molt showing variation in replacement within each geographic group. Height of columns indicates per cent of first-year population replacing the total numbers of primaries specified at bases of columns. Primaries one and two usually replaced simultaneously. *a, L. e. borealis* and *L. e. invictus; b, L. l. ludovicianus; c, L. l. migrans* S.; *d, L. l. migrans* N.; *e, L. l. excubitorides* S.; *f, L. l. excubitorides* N.; *g, L. l. mexicanus* (6 individuals only); *h, L. l. sonoriensis*. For explanation of geographic groups see figure 40.

correspondingly, variation in the replacement of the inner secondaries also is slight.

Greater secondary upper coverts.—These coverts are replaced almost uniformly in *L. ludovicianus* except for the northern populations of *migrans* and *excubitorides*. The two races of *L. excubitor* are

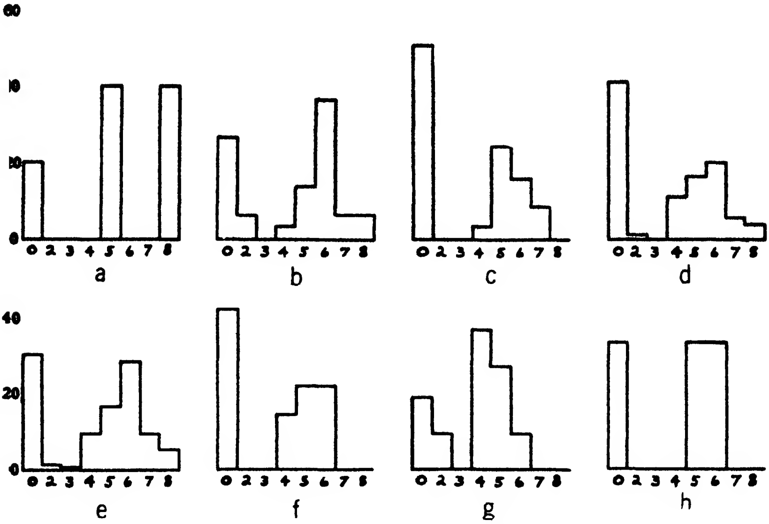

Fig. 43. Geographic variation in number of primaries replaced at first fall molt showing variation in replacement within each geographic group. Height of columns indicates per cent of first-year population replacing the total numbers of primaries specified at bases of columns. Primaries one and two usually replaced simultaneously. *a, L. l. grinnelli* (5 individuals only); *b, L. l. nelsoni; c, L. l. nevadensis; d, L. l. gambeli* S.; *e, L. l. gambeli* M.; *f, L. l. gambeli* N.; *g, L. l. anthonyi; h, L. l. mearnsi* (3 individuals only). For explanation of geographic groups see figure 40.

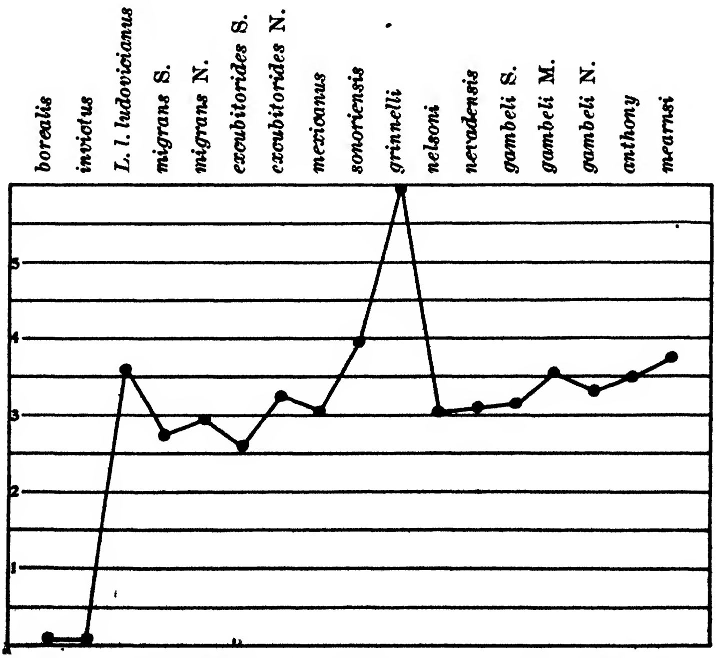

Fig. 44. Geographic variation in number of secondaries replaced during first fall molt. Dots mark average number of secondaries replaced in each group. For explanation of geographic groups see figure 40.

widely different from *L. ludovicianus* in this respect as well as in the matter of secondary replacement.

Rectrices.—The replacement of the rectrices was not tabulated for each feather separately, the specimens being placed in one of three categories, those with new, partly juvenal, or entirely juvenal tails. Replacement corresponds partly with the replacement of primaries although many more birds replace rectrices than primaries. Since

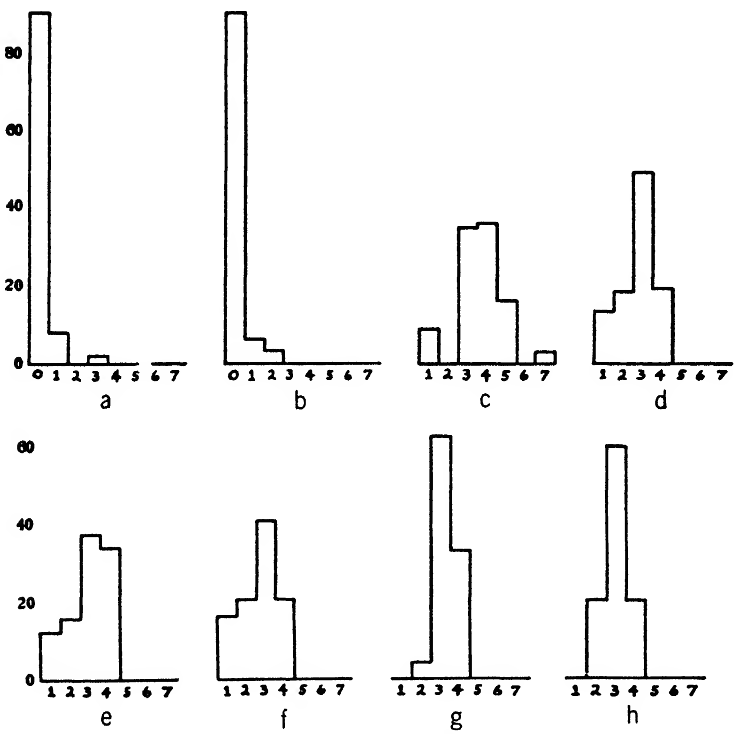

Fig. 45. Geographic variation in number of secondaries replaced at first fall molt showing variations in replacement within each geographic group. Height of columns indicates per cent of first-year populations replacing the total numbers of secondaries specified at bases of the columns. *a*, *L. e. borealis*; *b*, *L. e. invictus*; *c*, *L. l. ludovicianus*; *d*, *L. l. migrans* S.; *e*, *L. l. migrans* N.; *f*, *L. l. excubitorides* S.; *g*, *L. l. excubitorides* N.; *h*, *L. l. mexicanus* (5 individuals only). For explanation of geographic groups see figure 40.

rectrices may be molted after the fall migration, it is not surprising to find an inexact correlation of tail replacements with latitude of breeding habitat.

The individual variability in the completeness of the first fall molt within any single geographic group seemingly is associated with general physiologic tone. It has been shown that runt individuals are nearly always below average in the number of feathers replaced. It

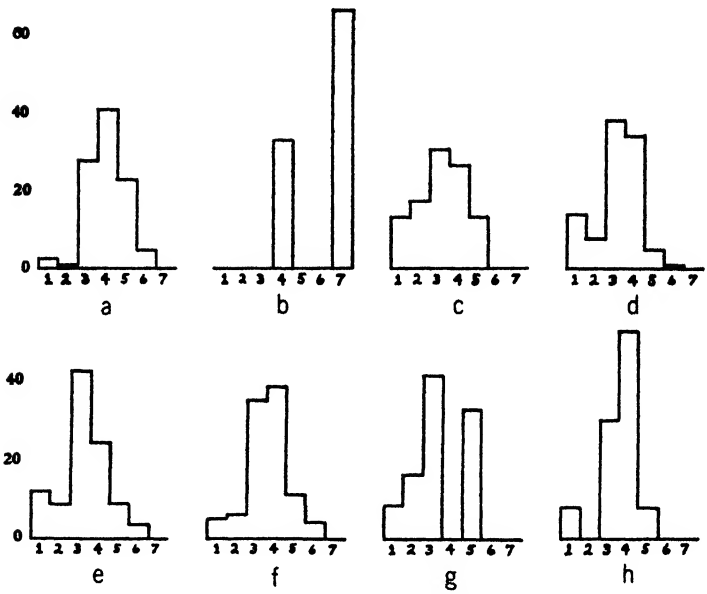

Fig. 46. Geographic variation in number of secondaries replaced at first fall molt showing variation in replacement within each geographic group. Height of columns indicates per cent of first-year populations replacing the total numbers of secondaries specified at bases of the columns. *a, L. l. sonoriensis; b, L. l. grinnelli* (3 individuals only); *c, L. l. nelsoni; d, L. l. nevadensis; e, L. l. gambeli* S.; *f, L. l. gambeli* M.; *g, L. l. gambeli* N.; *h, L. l. anthonyi.* For explanation of geographic groups see figure 40.

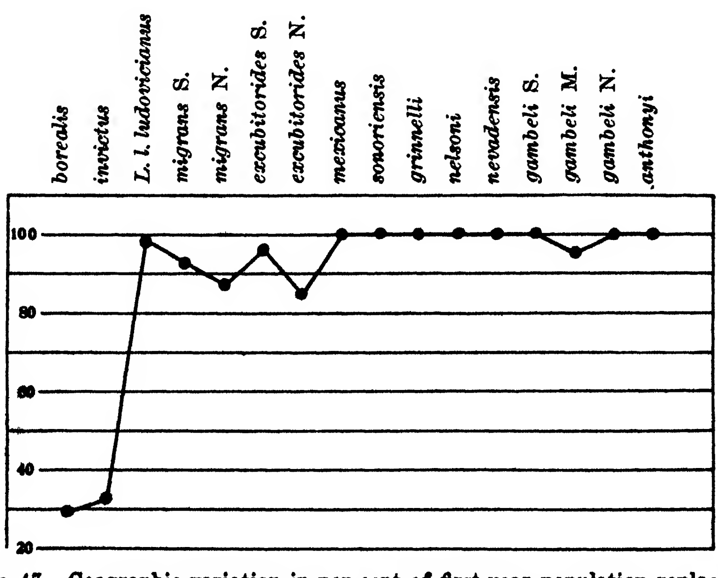

Fig. 47. Geographic variation in per cent of first-year population replacing all greater secondary upper coverts at first fall molt. For explanation of geographic groups see figure 40.

is of interest also that these same inferior individuals display the most pronounced vermiculations and the brownest tones of color of any members of their race.

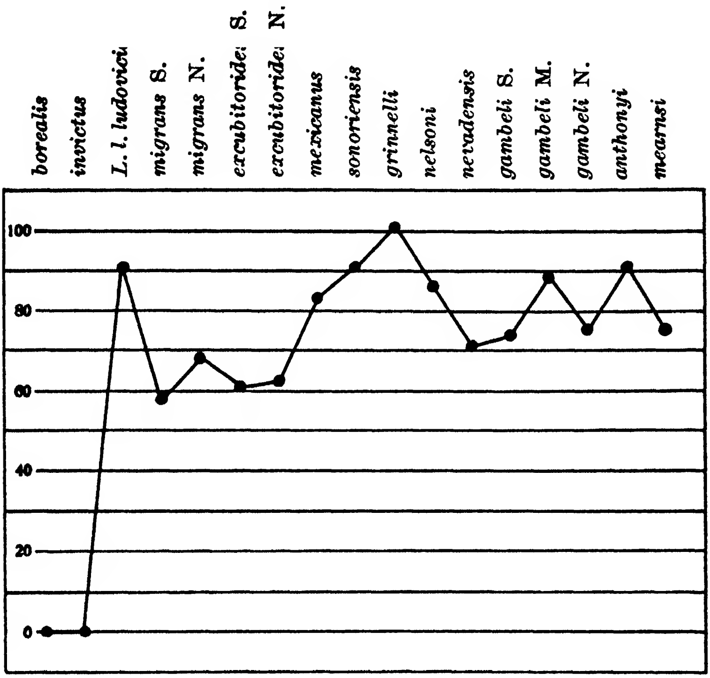

Fig. 48. Geographic variation in per cent of first-year population replacing all rectrices at first fall molt. For explanation of geographic groups see figure 40.

PRENUPTIAL MOLTS

L. excubitor differs from *L. ludovicianus* in undergoing a more complete prenuptial molt during the first spring, frequently thereby losing large, but often irregular, areas of the brown first fall plumage from the back, head, and shoulders. Also, the vermiculated feathers of the throat frequently are replaced by unmarked feathers. The molt, as far as known, occurs in March and April and is associated with the change of the bill from brown to black (p. 20).

Little is known of the adult prenuptial molt in *L. excubitor*. It is probably similar to that of the first year but possibly less extensive and certainly does not alter materially the appearance of the plumage. The principal change to be noted in the adult is the appearance of a black bill.

ANNUAL MOLTS SUBSEQUENT TO THE FIRST YEAR

The sequence of feather replacement in this molt in *L. ludovicianus* requires no further comment. *L. excubitor* is not known to differ from *L. ludovicianus* in the annual molt except that the molt occurs more rapidly. The few available molting *invictus* from Alaska indicate that the process is completed in about two months, July and August, perhaps also early September.

Migration

Migration in American shrikes is an irregular and variable habit, rarely finding equal expression in all segments or even individuals of a population. There is no evidence whatsoever that shrikes group together and travel in flocks over narrowly defined migration routes arriving on, or departing from, the wintering grounds *en masse*. This would hardly be expected of a bird of solitary habit, and yet this kind of migration does occur in certain hawks, as, for example, in *Accipiter velox*, which is solitary at seasons of the year other than those of migration. Neither are the species of shrikes concerned known to migrate at night. It is possible that there is some difference in the time of arrival or departure of the two sexes but, likewise, such differences are at present unknown, chiefly as a result of the close similarity of the two sexes, which limits pertinent observations to birds taken as specimens. The shrikes which are partly or entirely migratory are *borealis, invictus, migrans, excubitorides, gambeli*, and *nevadensis*. All other races are resident.

L. ludovicianus.—An important factor in the occurrence of migration in this species seems to be the extent of time that snow lies on the ground during the winter. A chart showing for all parts of the United States (Kincer, 1922, p. 43, fig. 78) the average number of days (not necessarily consecutive) each year that snow covers the ground indicates that the permanently resident populations without exception occupy areas where snow cover does not average more than ten days each year, and usually averages much less, or does not occur at all. Populations breeding in regions which in winter have more than ten days annually of snow cover for the most part migrate in the fall to regions where snow is practically lacking. Thus, in the race *migrans* there are groups of birds in Arkansas, northern Mississippi, and probably also in northeastern Texas and eastern Oklahoma, which

seem to be permanently resident. In regions where the snow cover averages between ten to thirty days annually, wintering shrikes occur, but usually in much less abundance than during the breeding season. In regions with still greater snow cover, winter records of *L. ludovicianus* are extremely rare and probably coincide with seasons less severe than the average. Consequently, it would appear that shrikes of this species migrate at least indirectly in response to the degree to which their foraging on the ground is disturbed by snow. This is a principle which has been applied commonly to many migratory species but which I feel has particular significance in this case, for a Loggerhead Shrike perforce is required to hunt chiefly on the ground. The species does not seem inclined to hunt with any regularity in bushes or trees, neither is it adapted to dig or scratch through light coverings of snow. In searching for food a shrike depends largely on the motion of its prey. *L. excubitor* may obtain food in the form of small birds and mammals during the winter, but the variety of small vertebrates which a Loggerhead Shrike can readily overpower and eat is perhaps sufficiently limited not always to provide a reliable source of winter food.

During the winter of 1930 near Pinole, Contra Costa County, California, several opportunities arose to watch examples of *gambeli* under moderately severe weather conditions. On one occasion on February 25, a California Shrike was watched while feeding in a heavy rain which later turned into a brisk hail storm lasting about half an hour. During almost the entire storm this bird sat on a telephone wire exposed to the rain and hail, occasionally procuring food from the short grass on the hillside below. Its plumage became streaked and spotted from wetting but still it remained in the open. Only when the hail became so severe as to be decidedly painful as it struck the observer, did the shrike seek the rather ineffective shelter of a telephone pole, and later, a bare open bush. During the fall of hail, while in the bush, the bird caught a large sized Jerusalem Cricket (*Stenopelmatus*) which it impaled and ate. Other birds, such as meadowlarks, pipits, and Red-winged Blackbirds, disappeared from view during the storm.

Such a temporary resistance to cold and wet as above noted cannot be construed as indicating a possible endurance of the prolonged exposure that would be encountered in places experiencing severe winters with heavy snow. However, a certain hardihood on the part of the shrike appears to be indicated by the observation here reported.

The question arises whether or not the waning of the food supply and the covering of the ground by snow are the stimuli which bring about fall migration in each individual of a migrating population or whether it is the principle (Rowan, 1929) of migration in response to photoperiodism that initiates migration in *L. ludovicianus*. In Loggerhead Shrikes, as in many other species of birds, migration does not always coincide with changes in weather. No great amount of data relating to the coincidence of severe weather and migration in *L. ludovicianus* is available. It is perhaps sufficient to state, however, that, on the breeding grounds of the migratory populations of *migrans*, the average date for the first snowfall in the autumn is between October 16 and November 1, although in limited regions it may be between October 1 and October 15. Nevertheless, migration in *migrans* begins along the Atlantic coast in late August (S. W. Bailey, 1917, p. 214). Mousley (1916, p. 176) states that for two years the average date of departure at Hatley, Quebec, was September 4. Fleming (1907, p. 82) reports that this race leaves Toronto, Ontario, at the end of August. Similar circumstances prevail in the northern group of *excubitorides*.

The arrival of *migrans* on the breeding grounds ranges from March 25 to April 16 at Ottawa, Ontario, according to Eifrig (1908, p. 7). Fleming (*loc. cit.*) gives the average date of arrival at Toronto as April 3 and the earliest seasonal record as March 23 (1897). The birds migrate, then, early in the spring when weather conditions frequently are more severe and food is more scarce than during southward migration in the early autumn. The spring arrival of *migrans* in eastern Kansas is not noticeably earlier than farther to the north, for Dr. J. M. Linsdale informs me that his notes show that this race arrives on the breeding grounds chiefly in the latter part of March and early April.

Although it has been said that shrikes do not move in flocks, large numbers not arriving or leaving on precisely the same date, nevertheless, the incentive for migration operates on the bulk of a population at the same time. It would seem that in accomplishing the migration flight the Loggerhead Shrike moves short distances at a time, feeding along the course of its migration route either continuously or at frequent intervals. This opinion is gained from the manner of occurrence of shrikes during migration, that is to say, there are numerous records in the literature of single birds, seen but for a day or two, feeding about a locality not frequented by shrikes except at times of migration.

Migration for each individual, then, appears to be accomplished by means of some mechanism of the sort that Rowan has outlined for the junco, except that there is great individual variation in the effectiveness of the physiological and seasonal rhythms to initiate migration. For some reason, certain individuals, adult and first-year birds alike, fail to respond to the changing seasons. This may be seen in the number of winter records in northern latitudes indicated on the distribution maps (fig. 19). It is possible that psychic differences of the individual overcome what must be in shrikes a relatively weak physiological migration drive, and thus permit certain birds to remain on their breeding territories. It is difficult to visualize a purely reproductive physiological rhythm without psychic complications being so finely adjusted and possible of exact repetition by heredity as to account for the migration of northern California shrikes and, at the same time, the permanent residence of shrikes, seemingly identical structurally, in central California.

L. excubitor.—Grinnell (1900, p. 55) speaks of the arrival and departure of *invictus* on its breeding grounds in the Kotzebue River region, Alaska, as follows:

> During the fall the Northwestern Shrike was met with in the Kowak Valley rather sparingly. Single individuals would be seen, one or two in a day's tramp, in the willow bottoms where they were the terror of the redpolls. . . . On the evening of September 16th, ... three shrikes made their appearance in the cottonwoods nearby. For several minutes they chased each other among the trees. These three birds were probably of a single brood of the previous summer. . . . . None were seen after October 26, until March 22nd, when one was secured. During April and May they became fairly common, that is, for shrikes.

I have examined fall, winter, and early spring specimens from southern Alaska and points far north in Canada.

Repeated statements in the literature seem to indicate that the arrival of this species in the south is coincident with cold weather and often with the fall of snow. Belding (1903, p. 19) remarks that during the unusually severe winter of 1877–1878 the species was common at Marysville, California, where it is usually of rare occurrence. Similar statements are made relating to *borealis* in the eastern states, particularly at the southern border of its winter range. Early dates for fall arrival in such scattered regions as Colorado, Montana, Illinois, Ontario, and Massachusetts all fall between October 3 and October 24. That the species arrives in more southern latitudes slightly later than in southern Canada is fairly certain. Spring departure from the northern United States may occur as late as April 8 (Cameron, 1908, p. 49).

Migration in *L. excubitor,* then, occurs later in the fall than does migration in *L. ludovicianus* and usually is coincident with severe winter weather. Apparently *L. excubitor* is less fixed in its winter habitat than *L. ludovicianus,* for it seems to wander about in response to varying local conditions of food and weather.

The distances and routes which the migratory shrikes travel can be stated only approximately since shrikes are rarely banded. In *migrans* distances traversed by birds nesting in southern Canada might be as great as 1500 miles if these particular individuals happened to winter in Texas. On the other hand, birds from New England and Quebec may go no farther south than Virginia or North Carolina. The direction of the migration it is believed is principally north and south, except where the Alleghany Mountain region appears to deflect the birds of Ontario and the Ohio Valley toward the west during their southward course, and where the race moves west into eastern Texas and Mexico. Wintering *migrans* that occur in Texas and Mexico, judging from the frequent presence of characters somewhat intermediate between *migrans* and *excubitorides,* represent breeding populations west of the Mississippi River.

The migration route of *excubitorides* may be long if birds from central Saskatchewan move as far south as the gulf of Tehuantepec, a maximum distance of about 2100 miles. The direction taken in migrations is nearly due north or south along the east base of the Rocky Mountains. No eastward trend along the tributaries of the Mississippi River is to be found in the fall migration, for, although this may occur to a slight degree locally, no *excubitorides* are present among series of winter-taken shrikes, chiefly *migrans,* from Arkansas and Louisiana. In the El Paso district of Texas *excubitorides* may invade the range of the resident form, *sonoriensis.*

The migration route of *nevadensis* is relatively short. Winter-taken specimens of this race rarely are found more than three to five hundred miles south of the northern limits of the breeding range of the subspecies. The route of migration appears to run in a north and south direction except where it is deflected to follow the east base of the Sierra Nevada and San Gabriel Mountains; this race usually fails to cross these mountains, although a few rare exceptions have been noted.

Gambeli from Oregon, Washington, and Idaho are found commonly in the Imperial Valley, Coachella Valley, and Mohave Desert, California, and in western Mexico from Sonora to Morelos, a maximum

distance of 2000 miles which might be traversed in moving from the northernmost breeding grounds. The wintering *gambeli* in the southern San Joaquin Valley, California, are thought to come from the upper Sacramento Valley to the north, but they possibly also come from the Upper Klamath River region in California and Oregon, a distance of not more than four hundred miles.

The directions followed by *borealis* and *invictus* in migration would seem to be nearly north and south except for modifications due to the irregularities of the east and west coast lines of the continent. If the routes of travel deviated greatly to the east or west, an even greater mixture of the two races in winter than does occur might be expected (see winter range of *borealis*, p. 51). One specimen, no. 176441, U. S. Nat. Mus., which clearly is *invictus* has been taken at Syracuse, New York. Aside from this, no great eastward or westward movement in migration is indicated in the winter populations. The distances traversed by *invictus* are greater than those traversed by *borealis*, the distance from the Yukon region, Alaska, to northern New Mexico being over 2000 miles. The explanation for the greater southward extension of the winter range of *invictus* is to be sought in the presence of the Boreal and Transition life-zones far south in the Rocky Mountain region. Surprisingly little is known of the breeding of *borealis*. If northern Ungava be considered the northern limit of its breeding range, the distances traveled in migration by this race would not exceed 1200 miles.

Habitats

Breeding habitats of the subspecies of *L. ludovicianus* were necessarily described in the foregoing discussions of geographic variation. They need no further mention.

BREEDING HABITATS OF LANIUS EXCUBITOR

Borealis.—Turner (1885, p. 34) describes conditions at Fort Chimo on Ungava Bay, one of the few certain breeding stations of *borealis*, as follows:

> Winter begins (zero of temperature) about 1st of November and continues to the last of April. Snow falls every month in the year. . . . . Snow remains from the last of September to the end of May.
>
> The limit of trees ceases only 10 miles north of Fort Chimo. The principal trees are species of *Abies*, *Larix*, *Betula*, *Populus*, *Alnus*, *Salix*, and *Juniperus*.

Also (p. 238) he says of *borealis:*

Not common at Fort Chimo. Breeds there. Young, unable to fly more than a few rods, were taken by the hand at that place, June 30, 1884. Said to be common in the more southern portions (of Ungava). . . . .

Invictus.—In speaking of the breeding of *invictus* in northern British Columbia, Swarth (1926, pp. 56, 135) describes the discovery of a brood of young:

We found no nest, but on June 30 we collected a brood of six young, just able to fly; the nest must have been close by. The young birds huddled together in a spruce thicket, were being fed by one parent, which escaped. This was at the head of Cañon Creek (near Atlin), altitude 4000 feet, in a sparsely wooded mountain valley, close to the upper limit of upright timber. . . . .

On July 28 an adult male (no. 44900) was collected at the head of Otter Creek (about 3500 feet altitude). . . . .

The upper portion of Otter Creek (3500 to 4000 feet altitude) . . . . may be described as characteristic of vast areas throughout this region that lie in an intermediate position between the wooded lowlands such as border Lake Atlin and the timberless mountain tops. Willow is the dominant forest growth along the bottom of this valley, never as large trees but as densely growing, rounded bushes, rarely more than twenty feet high and usually much lower.

Fig. 49. Head of Cañon Creek, elevation 4000 feet, ten miles south of Atlin, British Columbia. Breeding grounds of *Lanius excubitor invictus.* Photograph taken July 18, 1924. Mus. Vert. Zool. no. 4403.

The winter habitats of *borealis* and *invictus* appear to be extremely variable, birds being found in mountain valleys, open prairies, about pasture lands, or in moderately dense woods and thickets. No attempt will be made, therefore, to characterize winter habitats of this species other than to state that the birds appear to avoid extremely arid regions and localities with warm winter climates.

WINTER HABITATS OF L. LUDOVICIANUS

Migrans.—In winter this race frequents habitats not widely different from those of its summer range. Where it winters within the range of *L. l. ludovicianus*, it is not always to be found associated with *L. l. ludovicianus*. In Louisiana it is probable that the wintering shrikes in the southern alluvial and prairies regions are chiefly *migrans*, according to Kopman (1915, p. 185). It is known that *L. l. ludovicianus* does not breed in these localities. In Virginia, North Carolina, and Alabama mixed winter populations of *L. l. ludovicianus* and *migrans* frequently occur. *Migrans*, however, in these regions does not encounter the maximum humidity characteristic of the breeding range of *L. l. ludovicianus*, which maximum is attained in the summer season. In Texas, *migrans* occasionally is found wintering in the breeding habitats of *excubitorides*.

Excubitorides.—Members of this race invade the habitats of the permanently resident form *mexicanus*. Numerous examples of *excubitorides* have been taken in the southern parts of Mexico although large numbers of the race winter with entirely non-migratory birds of the same subspecies in southern Texas.

Nevadensis.—This form winters extensively within the habitats of *sonoriensis* apparently occupying precisely the same localities as the more southern form. Many immature dark breasted *nevadensis* are found in southern Arizona and about El Paso, this plumage being readily distinguished from the much lighter immature examples of *sonoriensis*.

Gambeli.—Birds of this subspecies are found wintering in close association with *sonoriensis* and with *nevadensis*. Along the Colorado River, Grinnell (MS) notes that dark-colored winter visitant birds (*gambeli*, or possibly *nevadensis*) are found in the same localities as the resident form (*sonoriensis*), the difference in the two forms being visible in the field and the resident birds displaying greater shyness. In Morelos and elsewhere in Mexico *gambeli* winters with *mexicanus*. Collections from western Kern County, California, indicate a complete mixture of *gambeli* and *nevadensis* at this point in winter.

Therefore, some *gambeli* in winter leave the sagebrush regions of the northwestern United States and are to be found in a variety of habitats in association with permanently resident members of *nevadensis*, *sonoriensis*, and *mexicanus*, and with *excubitorides* which, likewise, winters in Mexico. Some *gambeli* probably winter with *nelsoni* in Lower California.

The extent to which the non-migratory races move from their breeding habitats in the autumn is believed to be slight. Under the discussion of territory it will be seen that many individuals of *gambeli* remain in precisely the same territory throughout the year. However, there are reports of *gambeli* which indicate that some individuals wander in late summer into regions previously uninhabited by shrikes. Thus, C. W. Michael and E. Michael (1921, p. 35) report the appearance on September 4, 1920, of shrikes in Yosemite Valley, California, where they are known to be entirely absent in spring. This and other instances may result from the necessity of seeking new territory following the annual spring increase in population. On the other hand, it is not certain that such invaders are not migrating individuals from breeding grounds far distant.

The presence or absence of thorny bushes appears to have little effect in determining the habitats of American shrikes. Impaling devices are so varied as to be available in some form in almost any type of habitat except for entirely barren prairies.

Territory

H. E. Howard's illuminating theories (1920 and 1929) on the territorial habits of birds find confirmations and certain significant modifications in *Lanius ludovicianus*. Unfortunately, I have no first-hand information regarding the territorial habits in *Lanius excubitor*. The Loggerhead Shrike is a solitary bird except during the breeding season. This preference for solitude during winter and fall is not merely passive but involves an active repulsion of other individuals of the species from the territory occupied. Howard's definition of territory links this concept primarily with the reproductive cycle. As used for *L. ludovicianus*, however, the term must be expanded to apply to seasons of the year when the obtaining of food for the individual, not the reproductive cycle, is the basic drive behind the possession of territory. My own studies of territory in shrikes are limited to resident populations of *gambeli* except for summer observations made of resident groups of *nevadensis*. Intensive field studies of *gambeli* have been conducted in the months of July and August, in November, and from January to June, as well as some more casual observations during September, October, and December.

Starting the annual territorial cycle at the close of the breeding season in early July, a period is encountered when the family groups

in the northern San Joaquin Valley, California, are undergoing disintegration. On July 3, 1929, at Firebaugh, Fresno County, California, a family group of shrikes was watched which seemed to be in the process of breaking up. At least three young were present and were heard to beg from an adult bird on several occasions; none was seen receiving food from adults but each was ably securing its own food. On one occasion two juveniles were pursued by an adult, seemingly in an endeavor to chase them from the vicinity. This same adult, which later proved to be an adult male, sang at frequent intervals. It repeatedly flew down to a cage containing three young shrikes which I had left in my car at camp. Here it attempted to get at the young, screeching and hopping about on the top of the cage. Following this, it returned to the telephone wires near by and sang. Obviously, its reactions were those of belligerence and repulsion toward other shrikes. No other adult shrike was permitted to come about the singing posts of this male. Several other adult shrikes were stationed in adjacent territories at distances of two hundred to four hundred yards. That one of these birds was the female parent of the young is highly probable. Certainly there was no other adult closely associated with the male in question.

This example of activity was found repeated elsewhere; for throughout the San Joaquin Valley adult shrikes were seen to be solitary and frequently singing, except for a few families in which the young still were being fed and wherein both parents were in evidence. In Kern County, California, an adult female *nevadensis* was stationed near my camp apparently without young and without mate. This bird sang nearly continuously, attacked my juvenal cage birds, and in every way appeared to be the solitary occupant and defender of a feeding territory. When shot, this bird was found to be in extremely worn plumage and was beginning the annual molt.

It may be concluded, that at the close of the breeding season, the family groups completely dissolve, including the adult pair, at least in most cases; each individual then seeks a feeding territory exclusively its own. Male and female may occupy adjacent territories but each hunts independently of the other and maintains its feeding area separately. Tyler (1919, pp. 122, 123) is of the opinion that the California Shrike mates for life. Curiously, his observations are drawn from nearly the same district in the San Joaquin Valley in which I have made a large part of my studies. Although his observations extend over a number of years, I think that in no case did he make

a concentrated effort to study the territorial relationships of individuals of this subspecies. In late fall and winter a few shrikes may again become paired, that is to say, they travel in close company, their feeding ranges being identical. It is possible that Tyler has been misled by this occasional early pairing which might seem to indicate that birds remain mated during all seasons. Possibly many pairs reunite in successive seasons but probably chiefly because the members of a pair form the habit of occupying the same nesting territory and not because of any especial individual attraction; in other words, it is my opinion that in shrikes any member of the opposite sex will suffice as a mate, but, that through territorial habit and memory of location, two birds often may be brought together in successive, although not continuous, matings.

In early August, 1929, a return was made to my former camp at Firebaugh, and a shrike, presumably the same bird that was observed at this point in July, again was studied. The bird occupied perches identical with those used in the preceding month, sang in the same manner as before, and maintained the same territorial boundaries. No young were in evidence and other shrikes repeatedly were chased from the territory. The bird was singing as frequently as in July but was in the height of the annual molt. When shot, it proved to be an adult male with gonads decidedly smaller than is usual during the breeding season. Shrikes were extremely abundant in the vinicity, each solitary and each endeavoring to maintain possession of its own territory. No records of paired shrikes were made during the first ten days of August, which time was spent in the San Joaquin Valley in concentrated study of this species exclusively. Several hundred solitary shrikes were noted.

By November, some few California Shrikes have become paired. Members of a pair were seen thirty yards from one another about five miles west of Firebaugh and birds of another pair, noted in southern San Benito County, were perched on opposite sides of a small country road. At this season a census of shrikes observed along roadways showed a total of ninety-three individuals noted in three days of continuous observation in central California. Many of these birds were watched for as long as half an hour at one time. Three pairs and a doubtful fourth pair were observed out of this entire number. Near Milton, Calaveras County, California, while traveling along a country road on November 29, 1929, I noted four successive solitary shrikes at intervals perched on the roadside fence. Each individual was

flushed, by the moving car, along the fence line for distances of one-quarter to three-eighths of a mile, whereupon each, reaching the limits of its territory, circled backward over the adjoining grain fields; in every case shortly after one shrike had turned back so as to remain within its territory another shrike soon appeared and repeated the performance, moving as far as the limits of its territory.

At Firebaugh on November 29 and 30, 1929, the territory of the adult male shot in August of the same year was reoccupied in essentially its original form, the new occupant using the same lookout posts but failing to use precisely the same twigs and wires as employed by the former inhabitant. On the morning of November 30 a shrike noted in this territory and watched for a short time was soon seen to be violently chased high in the air by the apparent owner of the area. The chase was accompanied by the sharp note, *bzeek,* several times repeated, indicative of excitement and usually associated with combat. The intruder was followed to the edge of the territory whereupon the defender stopped and engaged in a sex display commonly seen during the breeding season. This consisted of fluttering the wings and of begging notes similar to the actions of females during the laying and incubating periods. The bird which had been repulsed from the territory showed no response and the bird giving the display ceased and returned to one of its lookout posts. Unfortunately, both individuals were not obtained; the bird which had been driven away proved to be an adult male. The behavior noted may be interpreted in different ways. The two birds obviously were not paired at the time. There was some form of sexual excitement in one of the birds, presumably a female. The chasing of the two birds perhaps was a sexual flight but, judging from mating activities observed in the spring season, the flight represented a defense of territory. It appears to me that sexual excitation was awakening in the defending bird, but was not yet sufficient to overcome the impulse to remain in solitary possession of the feeding territory. At this season, a few individuals had yielded to sexual impulses so far as to tolerate association in a territory with a member of the opposite sex. Most of the birds, however, were either in the undecided condition of the two birds at Firebaugh, or they were inactive sexually. Since it has been shown that gonads diminish in response to photoperiodism (Rowan, *op. cit.*) it is significant to note that these mating activities occurred previous to the winter solstice. No perceptible change in the gross appearance of the gonads was observed in birds secured as specimens, in one case both members of a pair being obtained.

In the vicinity of Pinole, Contra Costa County, California, in early January, 1930, I located several single shrikes and studied and mapped their territories. Later, at the time when these shrikes paired and nested, there was no change in the size or limits of the territories, two birds and finally the entire family remaining within the confines of the area once occupied by but one of the parents. In most cases the sex of the original owner of the territory used for nesting was not known with certainty. In one instance a territory, for convenience designated as Pinole no. 6, was first located when seemingly but one bird was present. This bird later proved to be a female, fortunately, in this case, mating with a bird sufficiently different in coloration as to be definitely distinguishable in the field. The female, when discovered on February 7, I followed about over its territory for some time, and so I was able to outline the area which the bird occupied. This mapping of the territory required somewhere between fifteen and thirty minutes. Had the bird been paired at this time, I am confident from other experiences that the mate would have been seen. On February 10 a second bird, the male, had joined the female at no. 6 and they were constantly close together. The territory, as in other cases, was unaltered by the appearance of the second bird.

In another instance, that of a territory designated as Pinole no. 2, a single bird had been watched for three weeks in January. Later it became mated and the members of the pair were observed constantly together from January 30 to February 14, when one of the birds was found dead in the road, too much mutilated to determine the sex. The remaining bird was singing and uttering the rhythmic begging notes that are given by males and females alike. It was producing some sort of sound almost continually, whereas before, it had been nearly silent. The bird was unusually wild and several times flew high in the air circling outside the normal boundaries of the territory. Its erratic actions seemed to indicate search and desire for a mate, either the missing one or some other. It was in effect advertising and searching for a bird of the other sex which it had become accustomed to find in this territory during the past two weeks. Three days later this bird had disappeared. The amount of singing might indicate that the remaining bird of the pair was a male, but this is not certain since females seem to be as aggressive as males in sexual displays of kinds other than singing. It is difficult for me to believe that the remaining bird, if it were the original owner of the territory, would give up its long accustomed domain merely because its mate, a visitor, had dis-

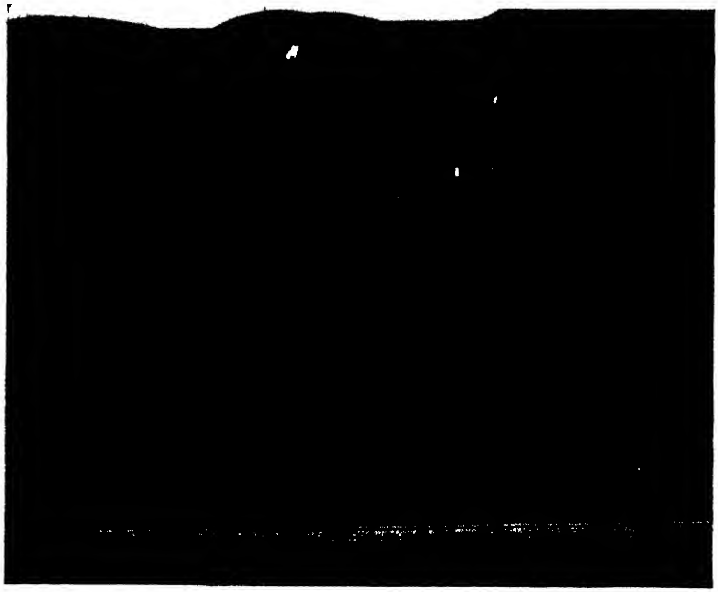

Fig. 50. Upper, west section of territory no. 6 near Pinole, Contra Costa County, California, inhabited by *Lanius ludovicianus gambeli.* Photograph taken April 30, 1930.

Lower, east section of territory no. 6 near Pinole. Clump of willows to right and beyond bridge used for nesting. Photograph taken April 30, 1930.

appeared. Rather it is likely that the bird that was killed, possibly a female, was the original owner. The remaining bird, which presumably deserted a winter territory of its own, had been moved to change its territory by sexual impulses when it first came to no. 2, and, having lost its mate, it wandered in search of another mate, especially since its attachment to territory no. 2 had not been of long standing. However, I cannot be sure that the remaining bird was not killed also, although no evidence to verify this could be found.

A minor exception to the customary fixity of the territorial limits was recorded at territory Pinole no. 4, where the pair was watched for some time preceding nest building. Later, when the nest site was selected, the birds shifted the territory slightly, abandoning one section one hundred yards in diameter farthest distant from the nest tree and acquiring a new region of similar size on the opposite side of the nest. The shift was probably brought about by reason of a lack of suitable nest site near the center of the teritory as formerly outlined. The shift was not hindered by the presence of other shrikes adjacent to this pair. In regions where nesting sites are scarce and at a premium, it is probable that considerable modifications of the winter and fall feeding territories take place when these are converted into breeding territories. To date, the reorganization of the breeding territories into fall and winter feeding areas is not well known. Seemingly one or another of the adults maintains possession of the nesting locality while the other members of the family seek territories unoccupied by shrikes and in some cases perhaps suitable only for winter and fall occupancy.

In migratory races, the separation of breeding and winter feeding territories being distinct, the occupancy and maintenance of territories must be altered accordingly. I have no information concerning the method of establishment of breeding territories in migratory races except that the same birds are said, on good authority, to return year after year to the same place to breed. In the wintering habitats of migratory races, feeding territories apparently are maintained but perhaps not with as much definiteness as in resident races. Certainly wintering migratory birds usually appear singly. It is extremely unlikely that mating occurs before the spring migration. Some resident birds normally mate as late as March and may mate much later in case of accident to one member of a pair.

The size and shape of the territory, whether breeding or feeding, since the two are similar in resident races, are dependent upon several

Fig. 51. Upper, part of territory no. 4 near Pinole, Contra Costa County, California. Line of willows in ravine used for nesting by *Lanius ludovicianus gambeli.* Photograph taken April 30, 1930.

Lower, clump of willows on territory no. 4 near Pinole used for two successive nests in the spring of 1930. Photograph taken April 30, 1930.

factors, namely: the floral habitat occupied, whether an open prairie or a moderately wooded area; the concentration of the food supply and the provision of nest sites; the local abundance of the species; and, the local associational or physical barriers.

TABLE 24

Estimated Areas of Territories of Shrikes in California

Race	Locality	Area in acres	Habitat
nevadensis	Grapevine Station, Kern County (1)	40	bushes 2 to 3 feet high, no trees, few fences, areas of bare ground.
nevadensis	Grapevine Station, Kern County (2)	32	bushes 2 to 4 feet high, one willow tree, sand dunes.
nevadensis	Lokern, Kern County	25	bushes 2 to 3 feet high, small willow trees, open plowed fields.
near nevadensis	Pond, Kern County	13	bushes 4 to 8 feet high, cotton fields, fences, eucalyptus grove.
gambeli	Firebaugh, Fresno County	15	bushes 2 to 6 feet high, a few willow trees, open plowed fields, telephone wires.
gambeli	Pinole, Contra Costa County (1)	12	grassy hills, willow trees, many fences, and telephone wires.
gambeli	Pinole, Contra Costa County (2)	14	grassy hills, willow trees, tule swamp, fences and telephone wires.
gambeli	Pinole, Contra Costa County (4)	13	grassy hills, willow trees, bushes 3 feet high, fences and telephone wires.
gambeli	Pinole, Contra Costa County (6)	12	grassy meadow, mustard stalks, many willows, one oak, fences.
gambeli	Pinole, Contra Costa County (7)	11	steep grassy hillside, oak tree, eucalyptus trees, grain fields, fences, willow trees, telephone wires.

From the foregoing table it will be seen that in California there is a marked difference in the size of territory which is coincident with racial differences and which apparently is correlated with habitat and concomitant variations in food supply.

In parts of the northern San Joaquin Valley, where the shrike population is large, nearly every individual's territory is bounded on all sides by other shrikes. But in the neighborhood of Pinole, shrikes occupy territories limited by physical and associational barriers. Thus, the pair at Pinole no. 6 was bounded to the south and northeast by steep hills, not prohibitive to shrikes, but not so desirable as the flat meadow which they occupied. To the east this pair was limited by the holdings of another pair of shrikes; I witnessed several encounters between the two pairs. To the west there was no change in association, no physical barrier, and no other shrikes, yet this pair moved only a limited distance in a westerly direction. Habit and lack of need for further foraging ground apparently had fixed the western boundary of the territory.

The manner of defending a territory is coincident partly with the foraging habits of the bird, which keep it in more or less conspicuous, open places. While a shrike is hunting for food, it can at the same time see large parts of its territory. Detection of invaders is by sight, less commonly by sound. When not engaged in active feeding, which often is conducted from low perches, the shrike always tends to mount to some high exposed position of observation. Here its ready visibility aided by characteristic form and contrasting markings (see Tracy, 1910) serves to advertise at considerable distances its possession of the region. This advertisement is aided by song and by the familiar series of from four to ten or twelve screeches of progressively diminishing intensity. Loggerhead Shrikes are in the greatest degree silent during the nesting season, at which time adult birds have reached the annual minimum in numbers and territorial boundaries are well established. More constant, though less ecstatic, songs and screeches are given in late summer and in autumn when competition in the possession of territories is more severe. The rhythmic summer song then seems certainly to be given for the purpose of warning invaders. A bird in summer or fall perched quietly on a wire or tree top suddenly, and without apparent reason, will break out with its series of violent screeches. No other shrike appears, the bird is not watching any particular prey, and it settles back again into quiet waiting. The screech seems merely an expression of the bird's presence, an indication of a potential aggressiveness to defend its position.

When an invader appears at a distance, a series of sharp notes of excitement, *bzeek*, *bzeek*, *bzeek*, are given by the defender, and sometimes answered by the intruder. The defender either at once, or in a few seconds, moves toward the intruder, which then leaves hurriedly or waits to be chased at a close distance in an erratic flight usually twenty-five to one hundred feet above the ground. The birds rarely come in contact. At Pinole no. 7, however, I witnessed a slightly more vigorous attack by the defender. Members of the resident pair were sitting on fence posts about ten yards apart, one bird, probably the male, singing occasionally. A succession of sharp notes (*bzeek*) was heard from a third shrike which had appeared at the edge of the territory about sixty yards distant. This was immediately answered by similar notes from the defending "male." The invader sang a few trills, then came closer, approaching the "male" of the resident pair and sat on the adjacent fence post. The "female" of the pair

was on the opposite side of the defending "male" who sat facing the invader. The two "males" remained rigidly on guard, neither moving in the slightest. One of them, I could not be sure which, gave a few song trills. After about five minutes both birds suddenly jumped into the air, the defending "male" came within striking range, and a series of sharp clicks of the bill and a few screeches, low buzzing notes, and staccato vocal notes were heard. The flight of the two continued for a few yards, when the defender returned to the "female," who had remained quiet and seemingly undisturbed throughout the performance. The repulsed invader towered in a most erratic manner and flew high over the hills at the edge of the valley half a mile away, apparently most intent on departing with rapidity.

I am forced to doubt Dawson's supposed instance of polygamy in the case of the Island Shrike (1923, pp. 600, 601), his observations being rather casual and the details of the incident perhaps obscured by the popular vein in which it is written. It is not the nature of Loggerhead Shrikes to tolerate the presence of adults other than mates.

In each territory there is usually what may be termed a headquarters. The roosting place, so far as known, is located here and usually also the nest if the territory is used for breeding purposes. The headquarters provide good lookout perches, feeding facilities, and some sort of bush or tree for shelter at night. It is occupied during a large part of the day. In many territories, nevertheless, subsidiary headquarters exist. If one wishes to locate a shrike in a known territory, a search in two or three favorable localities usually reveals the bird's presence. Evidently, therefore, all parts of the territory are not used equally, yet territories are defended in their entirety.

Three roosting places have been located in three of the territories which have been studied in detail. It so happens that all the roosts were in willow trees. In two of these instances the perch was located. The requisites for roosting places seem to be some support above the ground within a screen of overhanging limbs. Roosts are marked by conspicuous fecal deposits. In one instance, that of Pinole no. 6, the nest was built within six feet of a roost which had been used for a considerable period previously as evidenced by the abundance and age of the deposits on the limbs. In this case the female occupied the roost near the nest. The male roosted about fifteen feet away in a similar location among dense limbs, the site not being well marked probably owing to his recent arrival on the territory.

Since shrikes hunt relatively late in the evening and also early in the morning, at least in warm weather, it is difficult to observe the actions of the birds in roosting. On July 2 the shrike at my camp at Firebaugh went to the roosting tree at 7:30 P.M., forty minutes after sundown, but was heard to screech repeatedly from the tree until 7:50 P.M. At Pinole no. 2, on January 30, 1930, the pair of shrikes was watched feeding at dusk when they could be seen only when outlined against the sky. They were within fifty yards of the roosting tree. At 6:00 P.M. one was seen to fly to the willows near the roost and a few minutes later was flushed from its roosting perch. The sun had set over the low hills about forty minutes previously. These shrikes were silent at their roosts as they had been during most of the afternoon preceding. At Pinole no. 6, on March 15, 1930, the birds flew to their roosts thirty-five minutes after sunset, coming in from some point in the surrounding fields where they had probably been feeding. As they came into the trees, a begging cry, such as the female had given during the day, was heard, followed and interrupted by a few song trills from the other bird. No further notes were given. On this date this pair had a single egg in the nest. The female did not sit at night but used the roosting place near by, the same one which had been occupied previous to the construction of the nest.

At Firebaugh in August, 1929, shrikes were found to leave the roosting trees about one-half hour before sunrise, but before this they were awake and screeching for about fifteen minutes, starting at 4:30 A.M. On March 3, 1930, at Pinole no. 6, the male was foraging at 5:50 A.M., forty minutes before sunrise. The female was incubating on this date.

The seasonal variation in the length of complete inactivity at night varies for resident shrikes at latitude 38° in central California from about eight and one-half to thirteen and one-half hours. Cage birds sleep with the head partly concealed between the scapulars and the interscapular region of the dorsal tract; the head is not under the wing. In any one individual the head may be turned either to the right or to the left. In sleep the body feathers are elevated and the belly lowered so as nearly to touch the perch. Some birds sleep balanced on one foot, drawing the other up among the feathers. Shrikes are easily disturbed at night and will attempt to fly in total darkness if sufficiently alarmed. That they see poorly on dark nights is evidenced by the difficulty they have in avoiding twigs and branches when flushed from their roosts after dark.

Courtship

California Shrikes, while solitary immediately preceding the season of pairing, occasionally sing a few trills of the spring song, but for the most part they are at this time silent. It is not certain whether this is true for males and females alike, but, from the number of solitary individuals which have been observed in early spring, it is believed that both sexes have been watched, with no apparent difference between the two observable. As has been stated, it is not certain whether the male seeks the territory of the female or vice versa. It is possible that on occasion members of either sex wait in their territory until a visiting or neighboring shrike appears, whereupon some signal of sexual recognition serves to bring the two together. On the other hand, it is probable from evidence already presented that the male usually moves about seeking the territory of the female. Recognition of the opposite sex, I believe, is chiefly through some form of action, not by means of differences in color, song, or call note. The bird at Firebaugh which in November pursued a male invader and ended with a sex display such as I have seen only females give, doubtless by this display and the begging notes indicated its sex; more particularly it showed a condition of feminine excitation.

Pairs of individuals have been studied during the first few days of their joint occupancy of a territory, although the first meeting to result in pairing has not been witnessed. On January 24 at Pinole no. 4, members of a recently mated pair were seen sitting one foot apart on a telephone wire. The birds flew from the wire, one closely following the other. Upon alighting on a fence one of the birds gave a series of screeches of the usual rhythm but of a peculiar metallic quality, a note later found to be associated always with nuptial activities. The two birds then hopped and flitted back and forth from fence wires to fence post in what might be called a mock pursuit. After perching quietly for several minutes on the fence, one bird attempted to alight on the post occupied by the other shrike, whereupon the two again engaged in mock pursuit. Still later, one of the birds crouched near the other, fanned its tail, and at the same time tipped its tail upward. This action was followed by more of the metallic screeching, the performer twice flying back and forth twenty feet above the mate which remained perched on the fence. The flight was erratic and zigzagging with vertical undulations and changes in pace. It is believed that the bird performing this nuptial flight was the male.

In other pairs, during the first few days of mutual occupancy of a territory, also during the period following the destruction of a set of eggs, these same metallic screeches and erratic flights have been observed. Still other individuals interpolate hovering in the nuptial flight. The hovering is performed at a greater height from the ground than that which commonly is seen when shrikes are in pursuit of prey. It is similar to the hovering of excited parents while in defense of small young.

Courtship, therefore, chiefly consists of certain notes of excitement, characteristic nuptial flights, and sexual posturing. Courtship is not accompanied by great quantities of song, although what song is given is of an ecstatic type slightly different from the summer song. Songs are rendered, not while in close association with the mate, but when the two are more than a few yards apart and usually when the singer is on some high lookout post. It is known that at Pinole no. 6, where the members of the pair were distinguishable, the male did most of the singing, although this particular bird was relatively sparing with its song. But the female also may sing, and at no. 6 once was heard to do so, although but briefly. Her song was heard at the same time that the male was singing from a perch above her on top of a telephone pole seventy feet in height. The female's song was lower pitched and less powerful than that of the male, consisting of simple trills without high concluding notes. Nevertheless, this sample may not have indicated the full repertoire of her song.

In the early spring, the three or four days in which the first nuptial activities take place are followed by a period, variable in length, when the members of a pair hunt during most of the day, remaining within fifty yards or less of one another but rarely showing any other signs of attachment or of sexual interest. At Pinole no. 6 it was found that during this phase of breeding activity, the male usually took the initiative in moving about from post to post within the territory. At this time neither bird sings to any degree. Such sexual inactivity extends into the period of nest building unless the nest is being constructed rapidly, in which case the female has little time to behave in this leisurely manner. If birds mate in the fall, this inactive phase may last for several months. Second nests are built in great haste following the independence or destruction of the first brood of young, and accordingly anything comparable to this period of sexual inactivity commonly is lacking preceding the laying of second sets.

Nest Building

THE NEST SITE

The behavior of a pair in choosing the exact location of their nest is difficult to follow. As nearly as I have been able to observe the process, the pair, when searching for nest sites, makes an inspection of various densely branched trees and bushes near the headquarters of the territory. Both birds may spend fifteen minutes at a time hopping about through thickets of a sort not commonly frequented while feeding. This kind of activity was observed at Pinole no. 2 and no. 6. In the latter case, the nest finally was built on an old nest either of a shrike or a blackbird, which was placed on a limb where the pair had been seen prospecting in the fashion described. Both birds engage in this prospecting activity, staying near each other but not always following one after the other. After a nest is started behavior of this sort ceases.

The nest sites of Loggerhead Shrikes have certain general characteristics. The birds prefer locations in dense bushes or small thickly grown trees at medium heights, rarely less than three feet or more than twenty-five feet from the ground. Where possible the nests are hidden below the crown of the bush or tree and are placed on limbs which afford ample support for the comparatively heavy nest structure. The use of old nests as foundations for building new structures frequently is recorded. I have observed this in at least five nests of *gambeli*.

A review of the literature and data pertaining to nests of the races of *L. ludovicianus* provides the basis for the following brief generalizations regarding nest sites.

L. l. ludovicianus.—This race is known to place its nests in live oaks, pines, hackberry, orchard trees, hawthorne bushes, and grape vines. The height for recorded nests of this race ranges from five to forty feet from the ground.

L. l. migrans.—Included among the many types of trees and bushes used by this subspecies are apple trees, oaks, hawthorne bushes, osage orange trees, firs, pines, cottonwoods, willows, and wild plum trees. Recorded heights vary from four to eighteen feet. Patton (1884, p. 135) mentions the use of an old grackle's nest by a pair of these shrikes at Minneapolis, Minnesota.

L. l. excubitorides.—Principal among the nest sites of this form are the cottonwood and willow trees along the water courses in the Great Plains region. In Montana, Cameron (1908, p. 49) mentions the race nesting in cedars and box-elders as well as in cottonwoods. Nests are placed from ten to twenty feet from the ground (probably lower on occasion).

L. l. sonoriensis.—Mesquite, screw bean, palo verde, smoke-bush, and other desert trees and bushes of similar size afford nesting sites for this race. At Palm Springs, California, I have found several nests fairly well concealed in clumps of mistletoe in mesquite trees ranging in height from seven to fifteen feet above ground. Where broadleaf trees occur these shrikes may make use of such shelter for nesting.

L. l. grinnelli and *L. l. nelsoni.*—Mr. Griffing Bancroft kindly has provided me with the following information concerning his experiences with the nesting of these two races. He is unable to draw any definite psychological distinctions between the two. They are both comparatively rare and very widely scattered. Of the three nests of *grinnelli* and *nelsoni* which he has found one was in a Joshua tree, one against a bank and covered with a creeping vine, and one in the heart of a growth of tumble weed.

L. l. nevadensis.—Nesting sites of *nevadensis* include willows, cottonwoods, atriplex, Joshua trees, mesquites, *Purshia*, *Lepargyrea argentea*, and *Artemisia tridentata*. Nests may be placed as low as two feet in sagebushes. A nest taken at Lancaster, Los Angeles County, California, was located about five feet from the ground on a hanging limb of a Joshua tree.

L. l. gambeli.—Nests have been found by me in live oaks, willows, various orchard trees, cypress, sumac, atriplex, blackberry vines, acacias, pepper trees, and eucalyptus trees. The greatest height at which a nest has been noted is thirty feet from the ground in the top of an acacia. Bancroft informs me of the nesting of this race in loose tangles of bailing wire about four feet high and six feet long. Concerning the maintenance of the nesting territory, he states that there is no difficulty in tracing, through eggs and old nests, the fact that these shrikes maintain property interests in their respective règions (territories) and breed, year after year, in the same place and usually in the same bush. Grinnell (1911, p. 111) records an instance of this race, or intergrades between it and *nevadensis*, in comparatively barren terrane nesting between two upright boards of a support for telephone wires. Dawson (1909, p. 356) says that in eastern Washington the species nests in sagebushes, greasewood, and wild clematis.

L. l. anthonyi.—Dawson (1923, p. 600) mentions this race nesting in acacias and willows on Santa Cruz Island. Mailliard (1899, p. 42) found two nests on the same island, one placed in a brush pile, the other in a gum (eucalyptus) tree.

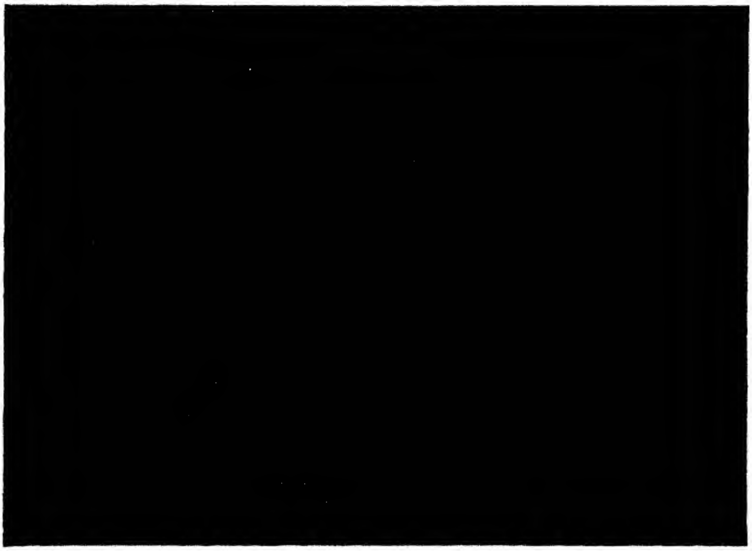

Fig. 52. Nest site and roosting tree of pair of *Lanius ludovicianus gambeli* on territory no. 6 near Pinole, Contra Costa County, California. Nest located in nearest tree on lowest limb to the right. Photograph taken April 30, 1930.

L. l. mearnsi.—A. B. Howell (1917, p. 89) speaks of nests placed a couple of feet from the ground in a "certain kind of thorny bush." This statement applies to the more barren parts of San Clemente Island. Where there are cañons on the island, Grinnell (1897, p. 20) and Howell (*loc. cit.*) report this shrike nesting in bushes on the steep cañon sides.

NEST CONSTRUCTION

The materials used in building the nests of *L. ludovicianus* are so extremely varied and so dependent on local supply as to confuse any differences that may exist in the nest constructing instincts of the various races. Mention has been made of the use of old nests, either of shrikes or of other species, as foundations for new nests. Shrike nests commonly have an ample substructure of twigs, usually not more than one-quarter of an inch in diameter. Occasionally the nest is a more or less homogeneous cup lacking a base of sticks. Grass is seldom used extensively but stalks of various annuals are employed,

often taking the place of sticks or twigs. The lining ordinarily is heavy, forming a thick felted cup with a wide margin which frequently projects outward a distance of an inch over the stick framework. The lining includes cotton-like substances principally, with smaller amounts of hair, feathers, rootlets, and bark. The lining is especially variable according to the local supply of materials. In sheep country much use is made of wool. Bancroft (MS) describes a nest of *grinnelli* composed of moss with a lining of plant down, apparently with few twigs or sticks anywhere in the structure.

Wide variation occurs even in nests from the same vicinity. The pair at Pinole no. 4 built an extremely inferior type of nest early in the spring of 1930. The framework was of small twigs and rootlets, rarely over two millimeters in diameter, which basal structure extended not more than one inch beyond the narrow rim of the nest cup. The lining was not over one-quarter of an inch in thickness and was composed of willow catkins, hair, and a few strips of bark. Likewise, the nest cup was unusually small, barely three inches in diameter and two inches deep. A second nest of the same sort was built by this pair, which was only slightly more substantial than the first. The first nest had become dislodged from its precarious position among the small twigs of a willow and had allowed the small young to fall to the ground. Further indication of the deficiency of this pair was noted when a remaining addled egg was found after the hatching of each of two broods of six young. In addition the eggs were unusually small. In contrast to the efforts of this pair, was the series of three nests built on territory Pinole no. 7, each of which was lined to the extent of nearly one inch in thickness. The cups of these nests were four inches across and the maximum diameter of the entire substructure of one of the nests was twelve inches. The same types of plant down and string were used in all three of the nests. The female at no. 7 produced large sized eggs and all of them hatched.

Nests may be situated either well braced in crotches of large limbs, against boards or other artificial supports, or among the fine dense twigs of bushes, trees, and vines. The desirability of large limbs as supports seems to be indicated by the fate of three nests which I have observed near Pinole. The young in these nests were allowed to fall to the ground or the nests became dangerously tilted as a result of placement among small branches one centimeter or less in diameter.

MacFarlane (1891, p. 444) gives the following description of the nest of *invictus* in Mackenzie:

A nest of the Northern Shrike, containing six eggs, was obtained at Fort Anderson on 11th of June 1863. This is in many respects in striking contrasts with the nests of its kindred species of the Southern States, far exceeding them in its relative size, in elaborate finish, and warmth. It is altogether a remarkable example of what is known as felted nests, whose various materials are most elaborately matted together into a homogeneous and symmetrical whole. It is seven inches in diameter and three and a half inches in height. The cavity is proportionately large and deep, having a diameter of four and a half inches and a depth of two. Except the base, which is composed of a few twigs and stalks of coarse plants, the nest is made entirely of soft and warm materials, most elaborately interworked together. These materials are feathers from various birds, fine down of the Eider and other ducks, fine mosses and lichens, slender stems, grasses, etc., and are skillfully and artistically wrought into a beautiful and symmetrical nest strengthened by the interposition of a few slender twigs and stems without affecting the general felt-like character of the whole.

As far as I have been able to discover, the female builds the nest without the active aid of the male. The difficulty of distinguishing male and female in the field makes it hard to be sure that this is always true. Judging from the actions of pairs in which the sexes of the birds were known, the male usually follows the female while she is gathering material and he may go with her to the nest but, in my experience, has not been seen to touch the nest or to bring material to the female. He may sit within one foot of the female while she is building. California Shrikes are extremely shy while engaged in nest construction and will cease activity when the nest is approached within sixty yards. It is difficult, therefore, to observe the manipulation of material at the site which is usually well hidden from view. Foraging for material is conducted, for the most part, within a radius of fifty-yards of the nest. The greatest distance that I have observed a bird transport substances designed for the nest is one hundred yards. Nevertheless, on occasion it is fairly certain that materials are obtained at even greater distances from the nest. At Pinole no. 6 the female was seen to go to an old Bullock Oriole's nest constructed of hair and tug vigorously at the edge, finally securing small pieces of the rim which it carried directly to its own nest. The male had been perched near the oriole nest and followed the female when she flew away with the nest material. The female at Pinole no. 4 was seen to bring a mass of short white cow hair which I procured, finding the mass to be two inches long and one-half inch in diameter. Females usually spend from thirty seconds to one minute adjusting the lining of the nest, following each trip in which they bring additional material.

I have seen the female at no. 6 make four successive trips at three minute intervals when actively engaged in making the lining. This

was between 8:00 and 9:00 A.M. After 9:00 A.M., and often earlier, building usually ceases and the birds feed about over the territory without regard for the nest. In the case of second nests, it is possible that building is carried on in the middle of the day although this has never been observed by me. Even in the early morning, the rapidity with which birds build varies greatly. Thus, although the female at no. 6 was seen to make rapid trips to the nest four times in succession, previous to this, no building was in progress for at least fifteen minutes. At no. 4 between 7:00 and 9:00 A.M. additions to the nest lining were never made more often than every twenty minutes. There follows from this variable rate of building corresponding differences in the total period occupied in construction. Birds at Pinole no. 6 spent from March 9 to 14, 1930, in completing the lining of their nest and were building at least as early as March 3. The pair at no. 4 spent from March 12 to 27 of the same year in lining their nest. This latter pair may have been delayed in part by several days of rainy weather toward the end of March. Contrasted with these examples, was the second nest built at no. 7 in 1930, following the destruction of the first set of the season, the second nest being constructed in its entirety in a maximum period of seven days between March 23 and 29.

During the final stages of nest building there is an increase in sexual excitement, this having been noted in several pairs. The female at no. 6 was seen to follow the male about, rapidly fluttering her wings, posturing, and uttering begging notes. This action was performed at some distance from the nest site but also was seen at dusk in the nest tree. At no. 7 one bird was seen to follow the other and squat and beg at a time when the lining of the nest was practically complete. These begging actions on the part of females would seem to accomplish two purposes: they serve to start the male feeding the female, which reaction seems to be important in the incubation period to follow; and they serve to stimulate both birds sexually, presumably leading to copulation although, unfortunately, this has not been witnessed during my studies. Begging by the female often follows upon her noticing the male in the act of capturing food, whereas at other times her actions seem to arise purely from some internal sexual urge. The begging of the female at no. 6 as the pair went to roost, I interpret as sexual excitement aside from the desire to be fed by the male.

Thus, in the concluding stages of nest building and in the one to three days which may elapse after completion of the nest and before the eggs are laid, there is a second period of courtship in which copu-

lation must be accomplished and in which the feeding of the female by the male is commenced. This phase of activity differs from the sexual activities at the time of the first meeting of the pair, in that the female in this later period is the aggressor. The male usually is quiet and non-responsive to the female and may consistently move away from her advances. If he does respond to her entreaties, it is by rapidly and quietly approaching with food in the bill, which food is snatched from him by the female. If he responds in a more purely sexual manner, it is by a few quickly repeated ecstatic song trills. I have never seen any strutting or display of plumage by the male at this time. Often there is a noticeable increase in the amount of song delivered by him, although this is not given while in close company of the female but, as before stated, from one of the higher perches in the territory.

As the set of eggs is being completed, this second phase of courtship gradually subsides. The male feeds the female with less coercion. He continues to sing frequently until the inception of incubation when more of his time is spent in foraging.

I am aware that numerous casual statements have been made to the effect that the male aids in nest building. This is implied in Knight's book on the birds of Maine (1908, p. 472). Although my studies have failed to confirm such reports, it would be unwise to claim that the male never aids in construction. I am inclined to relegate statements of this kind to that group of traditional writings on life-history which commonly are passed on from one author to the other and yet are not founded on well proved facts.

Eggs

SIZE OF SETS

The usual set in *L. l. ludovicianus, migrans*, and *excubitorides* consists of five or six eggs. There are records of sets as large as eight and as small as four but these extremes are to be considered abnormal. Sets of seven eggs occur less commonly than do those of five or six. In *gambeli* in the vicinity of San Francisco Bay, sets of seven eggs are as common as those of five, six being the usual number. In San Diego County, California, on the other hand, Bancroft states (MS) that *gambeli* lays five or six eggs, usually five. Likewise, I have taken numerous complete sets of five eggs in western Los Angeles County. Bancroft further says that the desert birds (*sonoriensis*) average a

larger per cent of sets of six eggs than do *gambeli* in southern California. Records for five nests of *nevadensis* show sets of five, six, six, six, and six. Known sets of *anthonyi* and *mearnsi* are of either five or six eggs.

From the foregoing it may be seen that there are but slight differences in the size of the sets in the races so far mentioned. Only small increases in the size of sets occur in the northern parts of the range of the species *ludovicianus*. However, in the Lower California races, *grinnelli* and *nelsoni*, as in other associated species of birds, the sets are decidedly smaller, being either three or four when complete. No records of sets of five are known although but few nests of these races ever have been found. The smallness of sets in the Lower California shrikes might be attributed to a comparatively sparse annual food supply which, it is believed, prevails for shrikes on this Peninsula, were it not for the fact that similar diminution in the size of sets occurs in other tropical and subtropical species in regions where food is seemingly abundant. Unfortunately, nothing is known of the size of the sets of eggs of *mexicanus*. Small sets in tropical regions seem due to the lack of a spring flux of food supply and to a lesser increase in day length, factors upon which the birds in temperate regions depend to aid in nourishing their relatively larger broods of young. Whether small sets in certain races of shrikes are compensated for by several broods or by a lower death rate is not known.

Sets of *L. excubitor* vary from six to eight eggs.

VARIATION IN EGGS

Eggs of the Loggerhead Shrike vary from dull white to either light neutral gray or buff in ground color. The spots are usually small, the maximum diameter in most eggs being about two and one-half millimeters but occasionally spots and splotches as large as six and one-half millimeters occur. The sharply defined surface markings vary from neutral gray to various tones of yellowish brown and umber. There also are indistinct light gray spots deposited in layers beneath the surface of the egg shell. Occasionally, fine black scrawlings appear near the large end of the eggs. Spots are more concentrated at the large end but rarely are grouped into pronounced blotches with intervening unpigmented areas. A wreath of spots about the large end rarely is present. Out of one hundred and fifty eggs of *L. ludovicianus* examined by me, six instances of reversal of the color pattern, that is,

heavy pigmentation on the small end of the egg, have been noted. Four of these examples were in the same set of eggs. Accounts of the eggs of *L. excubitor* indicate that they are similar in color and pattern to those of *L. ludovicianus*.

TABLE 25

MEASUREMENTS OF EGGS IN MILLIMETERS

Race	Number of eggs	Number of sets	Length				Width			
			Mean	Maximum	Minimum	Mean range in set	Mean	Maximum	Minimum	Mean range in set
migrans	16	3	24 9	26 4	24 0	1 20	18 6	19 0	18 2	46
sonoriensis	5	1	23 5	23 7	23 4	30	18 0	18 2	17 8	40
nelsoni (Bancroft, 1930)	4	1	24 3				18 2			
nevadensis	18	3	25 6	27 1	24 0	1 26	18 6	18 4	19 1	63
gambeli	97	18	24 1	26 9	22 0	98	18 5	19 4	17 3	56
mearnsi	5	1	24 1	24 3	23 9	40	18 1	18 2	17 8	40
invictus (MacFarlane, 1891)	6	1	28 2				20 3			

Table 25 shows measurements of eggs of some of the races, but especially the measurements of a series of *gambeli* in the Museum of Vertebrate Zoology. Further comparison with measurements of eggs of other races of *L. ludovicianus* has been omitted since egg size, shape, and markings appear to be constant within the species. A large amount of individual variation in size is to be noted, although eggs within a set are similar in size and proportions. The principal size variable is the length, the width being much more constant. In *gambeli* the range of variation in length is 20 per cent of the mean length, whereas variation in width is but 11 per cent of the mean width. The maximum variation within any one set is, length, 9 per cent, and width, 5 per cent; average variation in the sets is, length, 4 per cent, and width, 3 per cent. No certain correlation of size with the number of eggs in sets is apparent.

The weights of one hundred fresh eggs of *gambeli* are available, seventy-seven of which are those reported by Hanna (1924, p. 151) and twenty-three those weighed by myself. The average is found to be 4.64 g., maximum, 5.7 g., and minimum, 3.6 g. The range of variation is 47 per cent of the mean. Variation within any one set is only about 12 per cent of the mean.

TIME OF LAYING OF THE FIRST SETS

An attempt has been made to condense from the nesting records of the races of *L. ludovicianus* some statement concerning the average time for the laying of the first sets. The readiness with which shrikes replace nests which have been destroyed and the common occurrence of two broods in a season renders difficult the formulation of such a statement. It is certain that there are numerous departures from the dates outlined here. These departures are caused by local variations in the advance of the spring seasons.

L. l. ludovicianus.—Latter half of March and first half of April in Florida, South Carolina, and Georgia. Stockard (1905, p. 288) gives April as the month for the laying of first sets of eggs of this race in Mississippi. Wayne (1919, p. 288) records a set at Charleston, South Carolina, as early as February 15.

L. l. migrans.—Late April and early May. It is rare to find eggs of this race before the middle of April and in southern Canada most of the sets recorded occur in May. Possibly the populations of this race in the lower Mississippi Valley lay eggs in early April.

L. l. excubitorides.—Last week of April and early May from New Mexico to North Dakota and Canada. At Austin, Texas, Simmons (1925, p. 242) reports breeding in the middle of April.

L. l. mexicanus.—A full-grown juvenile taken June 7 indicates the breeding of this race as early as the middle of April. Probably the first sets occur in March and early April as in *L. l. ludovicianus.*

L. l. sonoriensis.—At higher elevations, around the 5000-foot contour, nesting does not take place before the middle of April. In the Coachella and Imperial valleys of California, however, first sets commonly are laid in March and occasionally in February.

L. l. grinnelli.—Last of February and early March. Juveniles out of the nest are common by the first of April.

L. l. nelsoni.—Last of February and March.

L. l. nevadensis.—Chiefly the month of April, but in the southern parts of its range the latter part of March (western Kern County, California). In northern Nevada first sets appear to be laid in May (Taylor, 1912, p. 408).

L. l. gambeli.—Ranging from April and early May in the north to late March and early April in the San Diegan district of California. Occasionally, sets of eggs are found in February in southern California.

L. l. anthonyi.—Eggs of this race have been found principally in April. Nevertheless, early records include a group of young from Santa Cruz Island just out of the nest on April 9.

L. l. mearnsi.—Several sets of eggs have been found in March. Young commonly are found out of the nest at the end of March, indicating that eggs are present also in late February.

Little authentic information is known of the nesting of *borealis*. The juvenile, no. 100640, U. S. Nat. Mus., taken by L. M. Turner at Fort Chimo, Quebec, June 30, 1884, indicates that *borealis* lays in the latter part of May. Similar juvenal specimens of *invictus* taken on June 30, 1924, from the vicinity of Atlin, British Columbia, by Swarth would show that *invictus*, likewise, breeds in May. MacFarlane (1891, p. 444) took a set of eggs at Fort Anderson, MacKenzie on June 11, 1863. It is doubtful that the American *L. excubitor* raises two broods in a season.

Eggs of *L. ludovicianus* are laid at approximately twenty-four-hour intervals and usually before 8:00 or 9:00 A.M. In the case of the first set at Pinole no. 7 in 1930, eggs were laid at from twenty-six to twenty-eight hour intervals, and accordingly, as near as could be determined, some were deposited during the late afternoon. On the morning of March 11, 1930, I was present at Pinole no. 7 at the time when the bird laid the second egg of the set. At 9:47 A.M. the bird was found sitting quietly on the nest, her tail showing over the rim. At 9:54 her tail was seen to twitch slightly and then move slowly from side to side, once or twice being jerked upward about half an inch. The bird then settled and became quiet as before. At 9:55 the male came into the tree, stopping six feet from the nest in some dense branches. He hopped through the limbs to within ten inches of the nest, his head lowered and pressed back against his shoulders. The female was perfectly quiet and the male then moved away from the nest. At 9:58 he sang for about a minute from the top of the nest tree. At 10:06 the female suddenly jumped off the nest to near-by twigs and immediately afterward flew from the tree. It is presumed that the pronounced motion of the hind quarters of the sitting bird as registered by the tail was associated with the deposition of the egg.

INCUBATION

TIME OF BEGINNING INCUBATION

Studies of *gambeli* have shown that incubation usually starts with the laying of the next to the last egg of the set. This was found to be true in three nests which were kept under daily observation. In all three cases, the last egg laid hatched about twenty-four hours after the other eggs; the first five eggs laid in each set hatched within six hours of each other. At a fourth nest, the first built at Pinole no. 7 in 1930, the bird was not sitting regularly until the sixth and last egg had been deposited. In the next set produced by this same bird a few weeks later, incubation began with the laying of the sixth egg, there being seven eggs in the complete set. I doubt if incubation ever is started more than two days before the completion of the clutch, as I have failed to find differences in the sizes of young birds or in the incubation of eggs within any one nest to suggest differences of more than two days in the inception of incubation.

Differences of a few hours in the time of hatching which occur between the first four or five eggs of a set seem due to individual variation in development; for, at Pinole no. 6, the eggs of the set having been numbered in the order in which they were laid, it was found that egg number two hatched one hour before number one, whereas egg number five hatched at least one or two hours after numbers one, three and four, and six hours after number two.

BEHAVIOR DURING INCUBATION

Incubation is performed solely by the female bird. Repeated visits to Pinole no. 6, where male and female were distinguishable, proved that the female was the bird incubating during all times of the day and also at night. In other pairs the two birds never have been seen to alternate at incubation. It is to be noted further that male shrikes do not develop incubating areas on the breast and belly. S. B. Benson (MS) notes that, in a pair of *nevadensis* taken with a nest and incubated eggs in Kern County, California, the male was without brood patch whereas the female possessed a well developed patch.

During the incubation period the female leaves the nest only for short intervals and depends largely upon the male for her supply of food. Usually the female attempts to return and cover the eggs within

five minutes after having been flushed from the nest, unless she is an especially wary individual. When settling upon the eggs, the shrike usually spends several seconds in moving about rather vigorously, adjusting the clutch so that it will be well covered and included between the two ventral feather tracts on the breast and belly. The incubating bird faces in various directions while on the nest, often turning toward an observer as if better to watch for danger. The bird seldom shifts about on the nest when once well settled. It has been repeatedly recorded in my notes that eggs in sets are arranged in a definite order in the nest according to the direction in which the bird previously has been facing during incubation. Sets of six eggs usually are arranged in a double row of three, the row paralleling the long axis of the bird's body. Whether the eggs are arranged in this fashion by some purposeful reaction of the bird or whether the arrangement is produced accidentally as the bird settles on the nest is not known. The aligning of the eggs in a double row appears best suited to the brooding of a large sized set by a bird of the narrow proportions of a shrike.

The male feeds the female either while she is on the nest or in the near vicinity of the nest when she has left incubation to meet the male. The food is not placed in the open mouth of the female but, as during the period before incubation, it is snatched from the male's bill and is swallowed at once or, if necessary, first is broken into pieces or impaled. When fed while incubating, the female either stands up in the bottom of the nest or else remains settled on the eggs and allows the male to approach close enough so that she can reach the food in his bill. When the pair is not at the nest, the male usually does not approach the female but waits for her to come and take the food from him.

At Pinole no. 6, between 6:00 and 6:30 A.M., the female was fed five times. On this date, March 31, 1930, sunrise was at 6:16 A.M. Later in the morning the male did not appear at the nest more frequently than every half-hour, and on a later date in the afternoon, forty-five minutes elapsed without feeding. Occasionally, the female may forage for herself within fifty yards of the nest tree; especially is this done if the male is absent. An estimate of the source of the food supply of the incubating female would place responsibility for the provision of at least 80 per cent upon the male. Begging by the female is less pronounced during incubation than during the laying period. Her begging notes are less intense and, although the wings

are fluttered, the tail is not spread and there is no squatting or posturing. A faint begging note and slight flutter of the wings was once observed while the female at no. 6 was settled upon the eggs; usually, however, she was silent while on the nest.

The male, although often remaining away from the nest tree for long periods, ordinarily is to be found within one hundred yards of the nest where he is occupied in foraging for himself and mate. There is a perceptible diminution of song on his part after incubation has commenced. Once the female at no. 6 gave a song trill upon leaving the nest which, in the particular instance observed, resulted in the immediate appearance of the male and delivery of food.

The male appears to stay close enough to the nest to be aware of any disturbance that might be indicated by alarm notes, begging notes, or conspicuous actions on the part of the female. The boldness displayed by the birds when the nest is approached by an observer is highly variable. They are less audacious than when there are young present. Some individuals approach within two feet of the observer, whereas others do not approach within one hundred feet or more. In the notoriously shy *mearnsi*, Grinnell mentions (1897, p. 20) that he found difficulty in approaching within gunshot of a pair of birds with nest and set of eggs. Similarly, some females tolerate an approach while incubating of one or two feet, others leaving the nest at distances of fifty to one hundred feet. Any one bird will vary in its boldness to remain on the nest, depending on the weather conditions, not on the advance of incubation.

Demonstrations at the nest in an endeavor to repulse an intruder include clicking notes, prolonged jay-like notes, *schgra-a-a*, and to a lesser degree the customary series of intense screeches of progressively diminishing intensity. Snapping of the bill has been observed during a rush toward the observer. In their excitement the tail frequently is fanned, and also flicked sideways, or up and down, the feathers of the back and head are elevated, the body is crouched with the head lowered, and the beak often is held open. Such attitudes are alternated with periods of fear when the feathers are adpressed to the body and the head raised accompanying a retreat, or anticipated retreat, to safer distances. The female has been seen suddenly to start begging during the height of her excitement. On other occasions shrikes have been seen hovering in the air over the nest tree or about the head of the observer. In some pairs the male is the more active defender while in others the female is the more aggressive of the two. Never-

theless, when there is no major disturbance in progress, the male is usually the one to chase other species of birds from the vicinity of the nest site. The following species I have seen pursued and chased away from the nest locality: *Colaptes cafer, Sturnella neglecta, Aphelocoma californica, Euphagus cyanocephalus, Agelaius phoeniceus,* and *Icterus bullockii.* Smaller species of birds do not seem to arouse the antagonism of the shrike. The species of birds here listed, of course, are not pursued beyond the boundaries of the shrike's territory but usually only from the nest tree or bush. Other shrikes are tolerated nowhere within the territory.

LENGTH OF INCUBATION PERIOD

In four sets of eggs of *gambeli,* in three sets of which each egg was marked in the order laid and this checked with the time of hatching, the incubation period was found to be at least sixteen days. In most cases one to six hours more than sixteen days elapsed before the young were entirely free from their shells. In view of the constancy of a bird's temperature and the faithfulness with which the females observed by me kept their eggs covered, I cannot hold confidence in the reports that eggs of this species hatch in as short a time as twelve to fourteen days. For example, see Bergtold (1917, pp. 99, 100). Evans (1891, p. 60) gives the incubation period of *L. excubitor* in Europe as fifteen or sixteen days.

HATCHING OF EGGS

The loss of weight in eggs starts with the beginning of incubation. The scales used by me in the field, which were accurate to one-tenth of a gram, registered no loss while sets were being completed. The total loss in sixteen days of incubation normally is 17 per cent but may range as high as 20 per cent of the weight of the egg when fresh. Addled eggs lose weight much less rapidly than normal eggs. The decline in weight seems to be uniform throughout the development within the eggshell. The weight of the broken eggshell, embryonic membranes, and excreta which are discarded at hatching amounts to 6 per cent of the weight of the fresh egg. The young bird starts its existence, then, 23 to 25 per cent lighter than the egg at the time it is layed; the young vary in weight corresponding to the variations in the weight of the eggs. Accordingly, weights of newly hatched young are from 6 to 8 per cent of those of the adult birds.

Two days previous to hatching, internal scratches or slight punctures of the eggshell may be noted near the region of greatest diameter of the egg. During the day previous to hatching, a single large outpushing of the eggshell, one to two millimeters in diameter, may be seen. Gradually other similar breakages are added until, shortly previous to the breaking open of the egg, an irregular zone or ring of these outpushings has been produced. The later stages in hatching vary in accordance with the way in which the shell chances to crack apart. One young bird was seen to lie for an hour in an egg in which there was a hole one centimeter across before finally breaking the shell completely. In other cases the eggshell splits open following one series of struggles on the part of the young bird, leaving the young one practically free from the shell. The handling of an egg which was ready to hatch once proved a sufficient stimulus to start the motions of the young which were successful in splitting the shell. As the young crack open the shells, the greatly dried allantois may stick to the abdomen and cause the lower half of the shell to remain in contact with the bird. At Pinole no. 6 the female was watched while she sat quietly on the nest during the morning of the day when five of the young hatched. She was seen to stand up suddenly, move to the edge of the nest, and then tug and pull at an empty eggshell which after three or four efforts was freed from the nest, carried to a distance of about twenty yards, and there dropped.

There is no evidence to indicate that eggs hatch at night but they may hatch at various hours of the day. A day-night rhythm of general activity is likely already in effect.

Growth of Young

The accounts which follow are based largely upon young *gambeli* at Pinole no. 6, upon a brood of *gambeli* raised from the age of three days, and upon a single juvenile captured as it left its nest.

First day.—Young just hatched are nearly dry, bright orange in color with apricot yellow bill and feet; the skin is smooth with few wrinkles and down is nearly lacking, being limited to two single rows of short white neossoptiles on each of the posterior abdominal regions of the ventral tract and a few similar neossoptiles on the elbows. In some broods two or three wisps of down occur on the dorsal region of the spinal tract. The neossoptiles are not over three millimeters in length. The posture of the young is that of the embryo, the neck

being strongly flexed and tucked down over the lower belly at times when the bird is not disturbed. The chief feather tracts on the body and wings are discernible but are less apparent than during certain stages of embryonic life.

For at least an hour after hatching the young bird does not beg for food, but soon after commences to raise the head when it is touched or when the nest is jarred. The margin of the open mouth is conspicuously outlined with yellow but the inside of the mouth is a deep pink with no special markings. Faint thin notes, *tsp tsp*, are given by the young as the head is held unsteadily upward.

The actions of the adults during the first day are not especially different from their actions during the incubation period, there being no increase in their efforts to defend the nest. The female broods nearly as constantly as during incubation. The male procures almost all the food for the family and delivers it to the female, who either passes it on to the young or eats it herself. On several occasions during the first and second day following hatching at no. 6, the male was seen to approach the nest and sit beside it while the female was absent. He refrained from sitting on the nest and did not feed the young. The food that is brought to the nest is of such small size as to be, to the observer, invisible within the bill of the adult. Dark-colored parts of insects may be discerned through the skin of the under surfaces of the young. What appeared to be the elytra of small beetles, one-half centimeter in length, were visible in one instance. The feeding of the young by the female is performed by a gentle dip of the head either while she is perched on the side of the nest or while standing in the nest. No fecal masses have been noted on the day of hatching.

Second day.—The young appear less vivid orange, the skin darkens slightly and becomes more wrinkled. The outlines of the feather tracts are more readily visible than formerly but do not yet show black pigmentation. A few of the feathers of the head are visible as gray spots beneath the skin. The eyes still are essentially closed although an extremely narrow separation of the eyelids may be seen when the head is raised and the mouth opened.

On this day some food visible in the bill of the male was brought to the female at no. 6 but was eaten by her and none of it given to the young. The female seldom begged as food was being received from the male. Between 10:00 and 10:30 A.M. the young were fed four times, the female often making two or three deliveries at one

feeding. At this time brooding is nearly continuous, even though frequently disturbed. The female occasionally jumps from the nest, turns to look into it, and then settles on the young again without either feeding or removing fecal masses. The male still captures the majority of the food for the female and young, although the female now forages more frequently than during incubation, rarely leaving the nest for distances of more than fifty yards. The male may forage at greater distances from the nest.

Young at this age, although their temperature drops when not brooded, are able to remain alive at temperatures of 70° Fahrenheit for periods of at least four hours.

Third day.—The dorsal feather tracts of the body and some of those of the sides and dorsal surface of the head show distinct dark, nearly black, pigmentation under the skin surface. The feathers of the spinal tract produce slight irregularities in the skin surface. The feather germs of the white ventral tracts are not easily seen but are as well developed as the dorsal feathers. Much of the down by this time has been abraded so that the young are nearly lacking in neossoptiles. The eyes are not perceptibly more open than on the second day.

The posture of the young is still that of the first two days, but the head is raised with more vigor and held erect with less tremor. When passing fecal masses the hind quarters are elevated and the head thrust down, thereby depositing the fecal mass, which is inclosed in a firm mucous envelope, in a position from which it readily may be removed by a parent. In the afternoon of this day, a captive nestling disgorged a pellet eleven millimeters in length which contained parts of dermestids and the hard muscular portions of the digestive tracts of snails which I had fed to it during the morning of the same day. Also included in the pellet was a nearly complete femur, nine millimeters long, of a small grasshopper which had been fed by the parents at least twenty-four hours previously. Others of the captive nestlings did not spit up pellets. Ejection of the pellet was preceded by about thirty seconds of gaping and writhing of the neck.

In the wild, between 10:00 A.M. and 12 M., young were found to have greatly distended abdomens and they did not appear to be hungry. The parents had difficulty in inducing them to raise their heads, for, several times, the female upon approaching with food waited on the nest edge and, failing in her attempt to feed the young, swallowed the food herself. On another occasion, when the young

failed to respond to the female that was seen to approach the nest with food, she gave a faint, low-pitched, burred note which resulted in an immediate begging for food. Seemingly an auditory stimulus had been necessary to arouse the brood. I then approached the nest, found the birds non-responsive to touch or to jarring of the nest, and attempted a rough imitation of the nest call that the female had just given. The response was immediate, several heads being raised. Apparently at this age the young are able to receive sufficient food in the early morning to satisfy their hunger for a period of several hours lasting through the middle of the day.

Fourth day.—Still further deepening of the pigment in the feather tracts, other than those which produce white feathers, is to be noted. While begging for food, the eyelids part, exposing one millimeter of the eye surface. The skin is much wrinkled and is a dark flesh color. The color of the bill and feet is faded to a dull flesh color except for the yellow margin of the open mouth, which is retained. The egg tooth is undiminished in size.

On this day for the first time, at no. 6, the male was observed to feed the young and at the same time was heard to give the nest call similar to that given by the female. The male fed only when the female was absent from the nest. If she was present, food was delivered to her. Captive young soon came to associate feeding with a clear whistle pitched near A above middle C; I always gave this note when the birds were fed. The young were responsive to whistles within about one whole tone of A but higher or lower pitched notes rarely excited them. The conditioned reflex involving the whistle and feeding, therefore, was established for a fixed pitch. The variation in pitch to which the young responded probably was due to the variation in pitch of the whistle given by me as much as to any lack of discrimination of a whole tone of pitch on the parts of the birds.

A large part of the food brought by the parents is visible in the bill. It was estimated that the female by this time is responsible for the capture of about 40 per cent of the food of the family. She still spends much time brooding and occasionally eats food brought by the male, rarely begging for it, however. The young may be left unbrooded for periods of twenty minutes, whereas earlier they were left for but intervals of about five minutes even at midday. The anxiety of the female to cover the young is regulated by the weather. Late in the evening at no. 6 attempts to return to the nest while I was weighing the young were more frequent and bold than at midday when temperatures were as high as 75° Fahrenheit.

Fifth and sixth days.—By the end of the sixth day the feathers of the spinal tract and ventral tract have become elevated about one millimeter above the surface of the skin, and the tips of many of these feathers have broken through the ends of their sheaths. The primaries and outer secondaries project two millimeters beyond the edge of the wing. The inner secondaries are much shorter, the innermost being less than five millimeters long. The dark feathers of the dorsal surface of the head are prominent beneath the skin but are elevated only slightly above the surface of the skin. The rectrices are no larger than the small feathers of the pelvic region. The egg tooth now is less prominent as a result of the growth of the remainder of the bill. When the young beg for food, the eyes are always well opened.

Young captive birds at the tenth day were about comparable to wild birds on the sixth day in respect to weight and feather growth. This was due to several setbacks which the captive birds received as a result of experimentation with their diet. Earthworms were found to be the only food procurable in large enough quantity to suffice for the young at this age. Grasshoppers and crickets could not be secured.

In the wild, brooding still occupies 50 per cent of the time of the female, who is forced to sit high upon the nest as a result of the increased bulk of the young. The male and to some extent the female are much more demonstrative against intruders than previously, coming closer and making more elaborate attacks upon them. This was noted in broods at Pinole no. 6 and no. 7. Frequently, the adults flew at the observer's head, coming within one foot. It has been reported by several competent observers that, at times, the parents will even strike the intruder during these attacks. In the late afternoon at no. 6 the young were hungry continuously, opening their mouths in response to all manner of stimuli and attempting to swallow fingers or even the wings of other nestlings that, through jostling, happened to be placed inside their open mouths. Nevertheless, the parents fed but three times in forty-five minutes. The posture of the young changes so that the heads rest against the side of the nest or over the backs of other young. From this posture the heads may be lifted rapidly to receive food. On the sixth day feeding of the female by the male is to be noted, accompanied by begging. This activity is rare at this stage of development of the young, however.

Seventh and eighth days.—Fig. 53 shows the growth of the feathers on the seventh day at Pinole no. 7. The characteristic posture of the

young is well illustrated, the head resting with neck outstretched and the eyes closed. The primaries may project from the skin as far as four millimeters at the end of this period. The wings at this time are growing so rapidly as to be unmanageable and usually droop awkwardly at the sides. The feet gain power sufficient to make difficult the removal of young from the lining of the nest to which they cling.

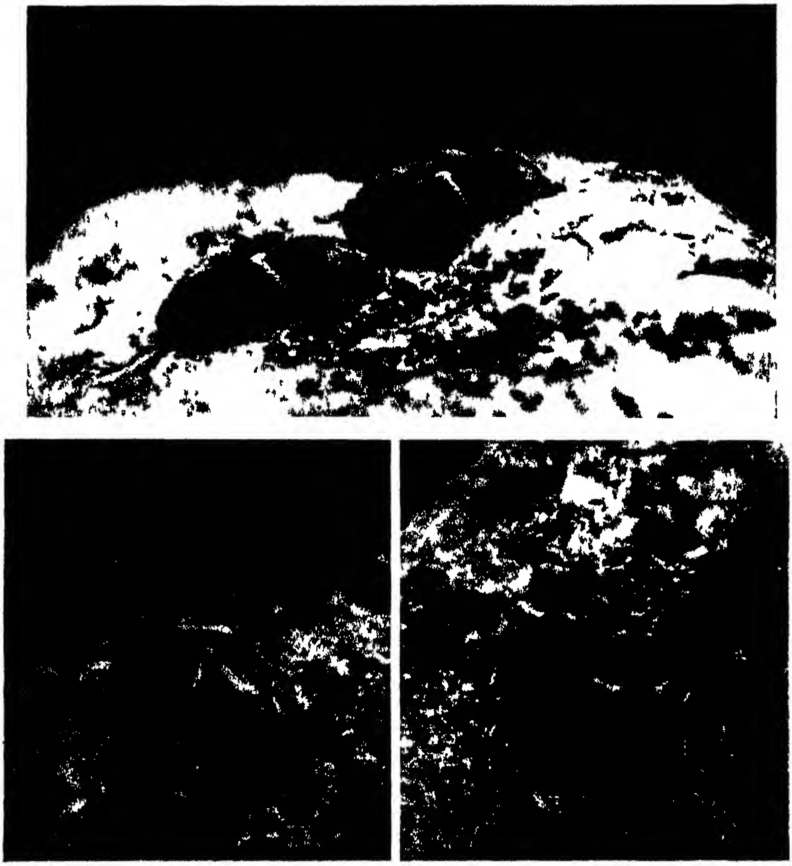

Fig. 53. Views of young *Lanius ludovicianus gambeli* seven days old from second nest of season built on territory no. 7 near Pinole, Contra Costa County, California. Photograph taken April 27, 1930.

The female bird broods much less constantly although still attempting to cover the young during most of the day. The frequent interruptions necessitated by feeding and the removal of fecal sacs, which are carried about twenty yards from the nest, limit brooding to periods of five to ten minutes in length. Increase of anxiety on the part of adults on these days makes difficult observations upon the

rate of feeding. There still is a period in the middle of the day when the young are not hungry. About 5:00 P.M. at no. 6 the nestlings commenced begging at my approach, whereas for two and one-half hours previously they had been unresponsive to my presence.

On the seventh day the brood at no. 6 was banded. The female, when allowed to return, eyed the nest and picked at the bands, soon lifting one of them up as though extracting a fecal sac. Finding the band attached to the young, she made a more vigorous effort and finally pulled the band and the leg up above the rim of the nest. The next effort dislodged the juvenile and the female started to leave the nest with the band in her bill and the young dangling beneath. She flew only six feet in the direction of the customary depository for fecal masses and then fluttered to the ground. Considerable consternation was registered by both parent birds; they inspected the juvenile as it lay on the bare ground and screeched and hovered over it. After ten minutes the female returned to the nest to brood. Fearing that the bird on the ground had been deserted completely, I replaced it in the nest. Subsequently, at each visit to the nest, the female made an effort to remove the bands, but never again proceeded so far as to extract a young bird. Finally, after about ten such efforts at intervals of five or ten minutes, each effort decreasing in intensity, the bird ceased to pick at the bands. Through repeated trial and error, she had come to recognize that this type of foreign material could not be removed successfully from the nest. On subsequent days the parents were never seen to touch the bands and no young were missing. It would be interesting to know if the male, who occasionally cleans the nest, learned to recognize the bands in similar manner. After the juvenile which had been dropped to the ground was returned to the nest, the female several times left the nest and hovered and hopped about the spot where it had been. The inference would be that the shrike does not count the number of young in its brood; furthermore, it returns to its young by reason of a memory for location, not necessarily because the young are sighted or heard. On the other hand, Gabrielsen (1921) was able to change the location of a nest a matter of six feet without the birds deserting.

Ninth and tenth days.—The body feathers reach three or four millimeters in length by the tenth day and must begin to furnish some protection from the cold. The bulk of the young is so great that the female experiences difficulty in covering them while brooding. Often, she tries to settle on the brood and, not being able to cover all the

young to her satisfaction, jumps off to return and repeat the attempt to huddle them under her feathers. A rainstorm in the night, which occurred while the brood at no. 6 was at this age, was weathered successfully by the young who were perfectly dry on the morning following. The plumage of the female showed plainly the effect of brooding during the rain; the edge of the nest was well soaked.

Eleventh and twelfth days.—Figure 54 illustrates the growth of the feathers. The dorsal surface shows few bare areas of skin when the wings are held close to the sides. The primaries and secondaries begin to break from the sheaths at the tips and the tail is five millimeters long. The angle of the mouth and the tip of the bill are the

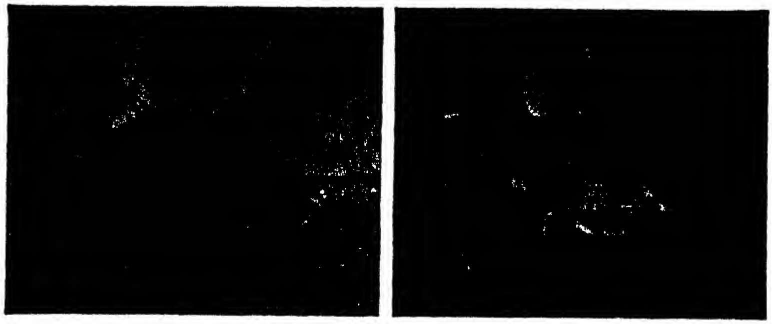

Fig. 54. Views of young *Lanius ludovicianus gambeli* eleven days old from nest on territory no. 6 near Pinole, Contra Costa County, California. Photographs taken April 16, 1930.

only parts about the face to remain light-colored. The egg tooth still is visible. The iris, as always, is brown but the pupil is bluish gray, not black as in adults.

The young cannot yet stand upright on the metatarsus and hold their heads erect, yet they keep the eyes open and watch objects that move about near them. When the parents are screeching, the young refuse to open their mouths and they lie quiet and low in the nest. After the parents have been absent for several minutes, they respond to touch with the hunger reaction and seem to lose their fear. The fear attitude is reestablished with the recurrence of screeching and fluttering by the adults. The food call changes from *tsp* to a husky *tcheek*. Fecal sacs are deposited on the nest rim, for the most part, not uncommonly after elaborate maneuvering in order to direct the hind quarters up and outward.

The adults become much more wary during this period, and brooding practically ceases. When away from the nest, the female often

sits near the male while he forages, as during the period previous to nest building. She procures at least half of the food of the young. Occasionally, she begs feebly from the male and may receive food which she eats herself. The male seldom brings food to be delivered to the young by the female, but instead, he feeds it directly to them.

Thirteenth and fourteenth days.—The tips of the remiges are free from the sheaths for as much as five millimeters. Preening is frequent and, although not noted earlier than at this age in the wild, it is seen to start in captive young as soon as the feathers of the body begin to break through the tips of their sheaths. The preening reaction of nestlings is a necessary activity, for an injured bird which failed to preen consequently failed to liberate the primaries from their sheaths and did not develop flight surfaces at the time when normal birds were beginning to use their wings.

The fear reaction of the young is more pronounced than previously but is lost after removal from the nest and after handling, particularly if the adults cease screeching. The young give the hunger reaction when being handled and still attempt to swallow objects, such as fingers placed in their mouths. While being removed from the nest, their fear is most pronounced, for they cling tightly to each other and to the nest lining and give hoarse screeches. Invariably they void a fecal mass when thus disturbed. The screech of the young greatly excites the adults who otherwise are relatively shy as is true throughout the period following the cessation of brooding. When placed on the ground, the young are able to clamber about, resting upon the full length of the metatarsus. The feet grasp at everything that comes on contact with them. More precocious individuals in the nest at no. 6 were able to perch on my finger in a most unsteady fashion. These more advanced individuals were those which were hatched from the larger eggs in the set, not necessarily the first to be hatched. Variation in this brood at this age, however, was not great except in the case of the last young to have been hatched. This bird was one day behind the remainder of the brood in its development.

On the thirteenth day at no. 6 it was noted that between 10:05 and 10:45 A.M. the young were fed but twice. The male on approaching the nest, fed one young, then sat waiting while several heads were raised, and finally fed a bird which raised its head still later from an opposite corner of the nest. It is possible that there is some system of rotation in feeding. Rarely are more than three young fed by a parent during any one visit.

Fifteenth and sixteenth days.—The young are well feathered at this age, the tips of the remiges forming a continuous flight surface. The only parts of the body not covered by feathers are the chin

Fig. 55. Nest of *Lanius ludovicianus gambeli* in eucalyptus tree on territory no. 7 near Pinole, Contra Costa County, California.
Left, young at age of seven days, April 27, 1930.
Right, young at age of fifteen days, May 5, 1930.

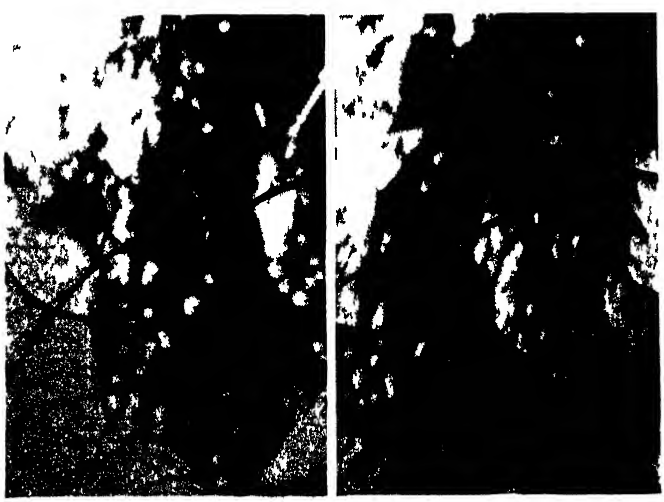

Fig. 56. Views of adult *Lanius ludovicianus gambeli* near nest shown in figure 55, Pinole, Contra Costa County, California. Photographs taken May 5, 1930.

and posterior belly. The weight of juveniles on the sixteenth day (twentieth day of captives) nearly reaches that of adults, there being no decline in weight previous to this time although the rate of increase

is relatively more gradual during the two or three days preceding (see fig. 58). It is likely that in the wild a marked drop in weight follows departure from the nest but this could not be determined at

Fig. 57. Adult *Lanius ludovicianus gambeli* in defensive attitude near nest shown in figure 55, Pinole, Contra Costa County, California. Photograph taken May 5, 1930.

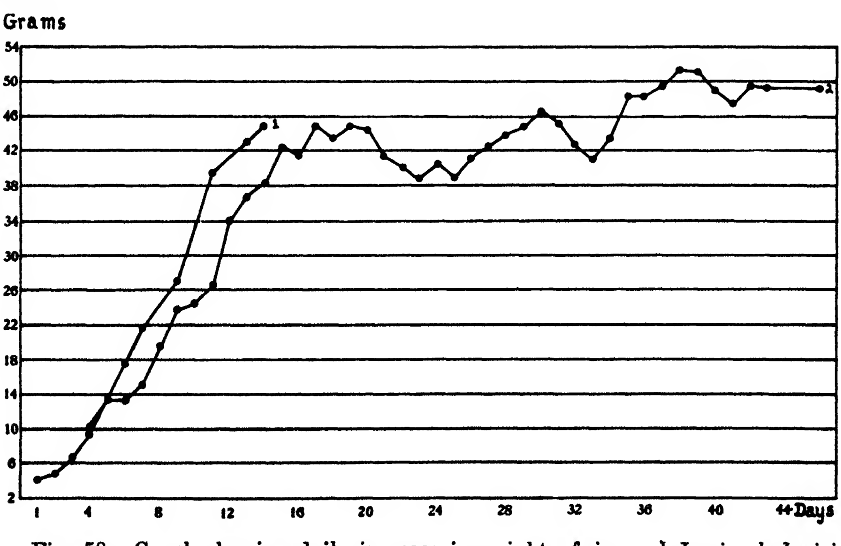

Fig. 58. Graph showing daily increase in weight of juvenal *Lanius ludovicianus gambeli*. *1*, nestling of average size reared in the wild in 1930 on territory no. 6, Pinole, Contra Costa County, California; *2*, largest of young raised in captivity from age of three days in 1929.

no. 6 as the young could not be captured readily on later visits. Juveniles shot after leaving the nest are usually lighter in weight than adults. In the brood raised in captivity a decline of about four or

five grams accompanied the first efforts of the young to hop about outside of the nest box. In this case the decrease commenced on the twentieth day, which probably is comparable to about the sixteenth day in birds raised under normal conditions.

During this period the young in the wild squat low in the nest when approached by the observer, and, when pulled from the nest, jump and flutter in their efforts to escape. They are belligerent and peck at the hand when captured. Only after continued handling do they become quiet. Handling of the young, and their screeches, make the adults frantic and at such times both parents, in their excitement, have been heard giving the begging notes. When the juveniles are left on the ground, they hop about giving a note indicated as *screig* which is uttered at intervals of from ten to twenty seconds. This note usually ceases when the young are placed on the limbs of a tree. The sound appears to be a "location note," that is, it serves to indicate to the parents the changing locations of the young.

The young progress on the ground by hopping, the entire length of the metatarsus touching the ground. In trees and bushes, they perch and jump distances of three to six inches, often falling and fluttering frantically as they cling to twigs and regain their balance. Progression on the ground or in trees is always upward. Young once removed from the nest when replaced usually will not remain but move off through the surrounding brush and, reaching a distance of several feet, sit motionless.

Seventeenth to twenty-first day.—On the seventeenth day at no. 6 the male was found to be missing but the female was engaged in feeding the young. The female seemed unusually shy and nervous, perhaps as a result of the disappearance of the male. On the previous day I had finally induced two of the brood to remain on the nest, but surprisingly, three other young had returned to the nest from the surrounding tree, a distance of at least ten feet in some instances. Only one of the three juveniles which had returned to the nest left as I inspected them at close range.

Young eighteen days old at Pinole no. 3 were fed by both parents a total of seven times between 8:00 and 8:10 A.M.

A captive bird taken from its parents when sixteen days old, during this period was very active in hopping about its cage and probing all manner of objects with its bill. On several occasions it pecked at spots on a plain piece of paper. Not uncommonly the bill failed to strike objects obviously attracting the bird's attention. Gradually

accuracy in striking with the bill was gained, probably as a result both of experience and the development of the musculature controlling the actions. This bird was able to climb a distance of seven feet up a vertical strip of half-inch wire screen, using the feet chiefly, but fluttering the wings and propping itself with the tail which was about four centimeters long. Flights of two feet were completed successfully at the age of twenty days.

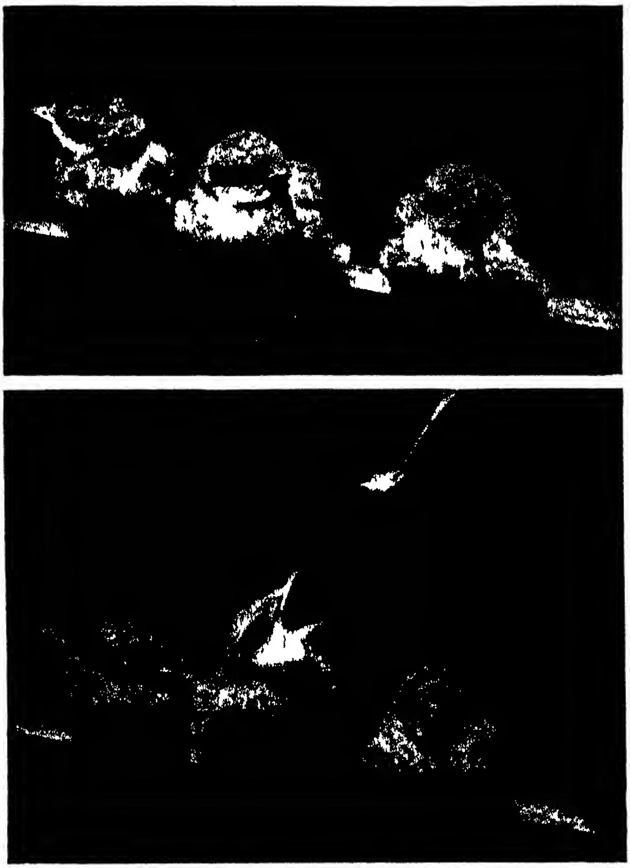

Fig. 59. Views of young *Lanius ludovicianus gambeli* nineteen days old raised in captivity from age of three days in 1929. Photographs taken April 26, 1929.

On the twentieth day four of the young at no. 6 still were perched on the much flattened and excrement-stained nest, which for only the preceding four days the parent had failed to keep clean. The young hopped off through the trees while I was yet six feet from the nest. This day may be considered as the normal time of final departure from the nest when broods are unmolested. Three of the brood at no. 7 had

left the nest, so far as known, of their own volition on the nineteenth day, the others left on the same day as I approached.

Concomitant with the beginning of hopping or flying, the feces lose the mucous sac and resemble the feces of the adult. This change may occur within a few minutes after leaving the nest. Feeding during this period occurs at short intervals. It was estimated that the solitary female parent at no. 6 brought food to her brood twenty-four times between 9:00 and 10:00 A.M. on the twentieth day. Most of the foraging was done within seventy yards of the nest. The six young of this brood all were in the nest tree or in the willow adjacent; they occasionally gave the "location note." When the female appeared in flight moving toward the nest tree, the typical rhythmic, wheedling or begging notes were given simultaneously by many, if not all, of the juveniles. This note had not been heard previous to the twentieth day. This latest and final type of food call of the young is accompanied by a flutter of the wings. Parent birds during this period are shy and usually do not attack intruders unless the young are captured or caused to move from their hiding places in the foliage of trees and bushes.

Twenty-first to twenty-fifth day.—In this interval the young remain concealed from view, only toward the end of the period beginning to appear on exposed perches. Most of the time is spent by them perched in the nest tree or within twenty yards of the nest site. Sufficient strength of wing is gained to enable them, on the twenty-fifth day, to negotiate flights of twenty to fifty yards. The young will allow an observer to approach within three to six feet of them but will not permit capture by hand. The brood prefers to remain close together, groups of three or four juveniles often perching within two or three feet of each other. The young may move short distances toward the parent when food is brought. The adults give a few warning screeches when observers are about the brood, but the young fail to sit quietly upon hearing such notes.

Twenty-sixth to thirty-fifth day.—In this period the parents continue to feed the young but at the same time the young are learning to forage for themselves. By the end of the period the juveniles frequently drop to the ground and feed although they beg and follow their parents when the adults are in sight. The young still tend to stay grouped together, but perch in conspicuous places much of the time. As early as the thirtieth day the young range over the entire territory but make their headquarters near the nest.

Fig. 60. Views of juvenal *Lanius ludovicianus gambeli* twenty-five days old on territory no. 6 near Pinole, Contra Costa County, California. Bird on ground smallest of brood, unable to fly up into trees. Photographs taken April 30, 1930.

Fig. 61. Captive juvenal *Lanius ludovicianus gambeli* at age of about twenty-seven days raised in captivity from time it left nest. Photograph taken April 30, 1930.

Feeding of the young has not been witnessed after the thirty-sixth day although it possibly may continue for a few days more. The problem of the dispersal of the young is but partly understood. At no. 6

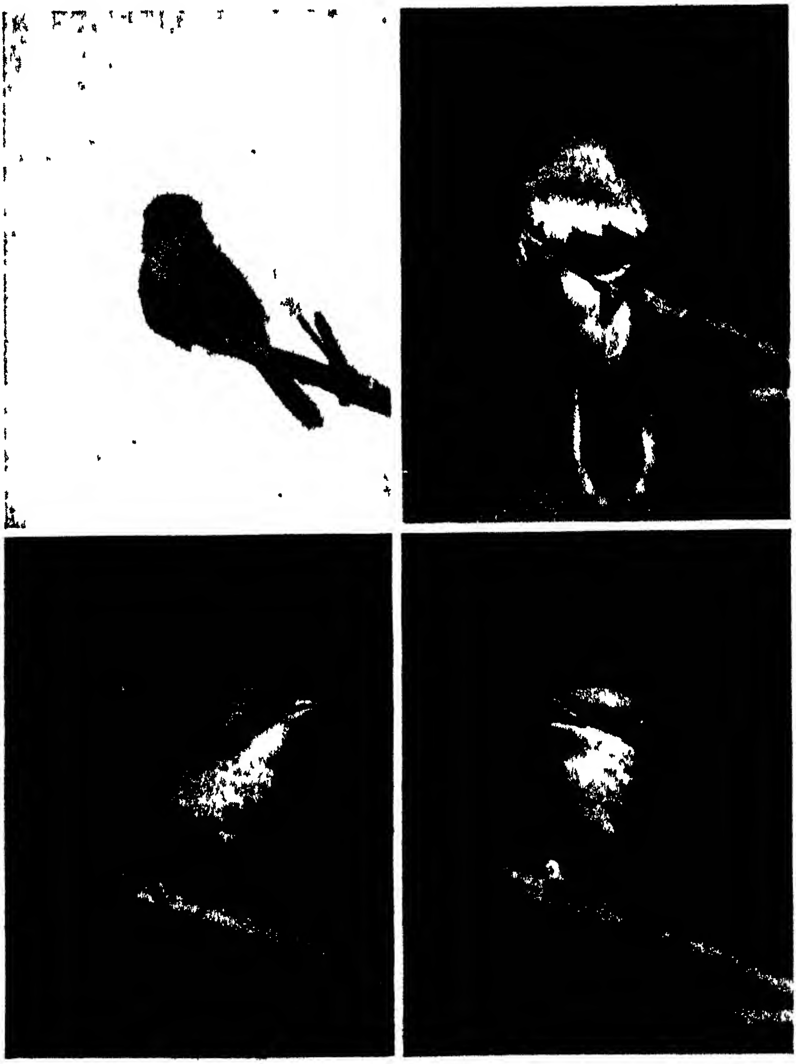

Fig. 62. Views of captive *Lanius ludovicianus gambeli.* Upper left, juvenile raised in 1930 at age of about thirty-two days; photograph taken May 5, 1930. Upper right and lower left and right, one of brood raised in captivity in 1929 at age of one year; photographs taken March 27, 1930.

the female disappeared and two of the young continued in possession of the territory for an additional month, at the end of which time only one young seemed to be present. On the other hand, young at

the age of forty-six days at no. 7 were still in a group feeding entirely for themselves on the edge of the parental territory, while the original pair was occupied with a subsequent nest and set of eggs. One of these young was shot on July 27, 1930, at the age of ninety-eight days, three miles south of the nest site. It would appear that when post-breeding feeding territories are established, the young, if still present on the parental territory, may be driven away by one or the other of the adults.

In cage birds begging is continued indefinitely. Live insect food is killed in captivity at the age of thirty days. Captive birds began drinking water and attempting to bathe on the thirtieth day. When thirty-nine days old, a bird sang the usual juvenal, mockingbird-like song for the first time, the first efforts being, to the human ear, rather grotesque. The clicking vocal notes develop on the twenty-fifth day in a feeble, but recognizable, form; impaling begins about the fortieth day.

Second and Third Broods

The Loggerhead Shrike is reported to raise two broods in a season. This is true for all the races of which the nesting is well known. C. S. Sharp (1907, p. 85) goes so far as to claim that *gambeli* in San Diego County, California, may raise three broods annually. The danger in attributing several broods per season to any one pair is obvious when it is considered that many late nests may be due to the unsuccessful termination of previous efforts. Relatively few observers have followed closely the actions of a single pair throughout a breeding season. For example, the pair at Pinole no. 3 lost their first brood of young when the young had been out of the nest about four days. The parents immediately started building a second nest. It is not at all certain that they would have built the second nest had they continued to feed the preceding brood for ten or fifteen days longer. The fact that nests occur far less frequently in the late spring than during the initial laying period would suggest that second broods are not raised by all pairs.

Although I have observed conclusive cases of second broods in *gambeli*, I seriously doubt whether three broods ever are raised to a state of independence in one season. In central California the minimum time required to build a nest, incubate the eggs, and raise the young is sixty-two days. Farther north the time might be shortened a few days as a result of greater day length during the summer and

consequent longer daily periods during which the young could be fed. It is not believed, however, that the time required for one brood could be reduced in this way more than about five days. To produce three broods, then, would involve six months of breeding activity. At northern latitudes where the species does not lay before the end of April, second broods are not fully fledged before the latter part of August, barely in time to start the migration southward. In the cases of the northernmost breeding forms, *borealis* and *invictus,* it would appear to me impossible to raise two broods annually.

On May 27, 1930, the birds at Pinole no. 7 were noted feeding young thirty-six days old. On June 6, ten days later, this pair was no longer feeding the young which, as stated previously, were occupying a corner of the parental territory. On this same date the parents were found to possess a nest with six fresh eggs. The new nest could not have been commenced when the young of the preceding brood were older than thirty-seven days and may have been started while the adults still were feeding the young.

This set of eggs, found on June 6, was the third set produced by this pair in 1930, the first set having been destroyed during incubation. Several other pairs under my observation have failed to raise second broods. Nice (1930, p. 73) mentions seeing a Migrant Shrike feeding juveniles and, at the same time, building a second nest.

The persistence with which shrikes replace destroyed nests often has attracted the attention of ornithologists, particularly those engaged in egg collecting. Jensen (1918, pp. 83, 84) records a pair of *migrans* at Wahpeton, North Dakota, which laid five sets of eggs before they were successful in raising a brood of young. A total of twenty-six eggs was laid by the bird, the total weight of eggs produced in the course of two months being more than twice the weight of the adult female. Atkinson (1901, p. 9) records a pair of *gambeli* which produced a series of six sets of eggs as a result of repeated robbing of their nests.

Nests subsequent to the first always are placed within the limits of the original territory and ordinarily within fifty yards of the previous site if suitable situations are available. There are authentic records of nests placed on top of old nests of either the same or preceding season. At Pinole no. 7 the first and third nests were within fifteen feet of each other in the same oak tree (see fig. 63). The second nest was thirty yards distant in a eucalyptus tree.

Second and subsequent nests are constructed with rapidity, the usual time required for nest construction and completion of the set

being ten to twelve days. In two instances it has been noted that the linings of the preceding nests have been used in new nests. Nice (1930, p. 72) has observed this in *migrans*.

Before laying the second set the sexual behavior of the adults runs through a hurried cycle comparable to the series of changes in behavior noted preceding the first set of eggs of the season. The male may engage in sexual displays, and always renews his singing. The female, coincident with the production of the set, begs from the male and receives food from him. The various sexual reactions, however,

Fig. 63. Central part of territory no. 7 near Pinole, Contra Costa County, California. A pair of *Lanius ludovicianus gambeli* in 1930 built first and third nests of season in oak tree on crest of hill; second nest built in eucalyptus tree above ruins of house. Photograph taken May 5, 1930.

of necessity follow so quickly one upon another as to be inseparable into the well defined periods or stages of behavior which are observed early in the breeding season. The period before nest building, which is lacking in sexual displays, and the period of the first joint occupancy of the breeding territory, of course, are partly or entirely lacking preceding the production of second or third sets of eggs.

If one member of a pair is killed during the nesting season, it is reported that second mates are found almost immediately, these second mates carrying on the nesting duties of the preceding mates without interruption (A. B. Howell, 1917, p. 89). I have noted that non-breeding birds may be found during the nesting season. The female at no. 6, however, did not find a mate while feeding young older than seventeen days.

SUMMARY OF IMPORTANT EVENTS TAKING PLACE DURING THE BREEDING SEASON IN LANIUS LUDOVICIANUS

In permanently resident races pairing takes place occasionally in the late fall but usually occurs in winter and early spring.

Birds do not remain paired throughout the year. Members of a pair may mate with each other in successive seasons.

There is some evidence to show that the male seeks the territory of the female just preceding pairing.

The size of a feeding territory occupied by a single bird is not increased with the arrival of a mate. The boundaries of a territory are changed after mating only as necessitated by a scarcity of suitable nest sites.

The nuptial behavior of a pair preceding the laying of the first set of eggs of a season may be divided into three periods: the early sexual displays during the first few days of joint occupancy of a territory; the period of sexual quiescence preceding and during nest building; the period of renewed sexual excitement, particularly on the part of the female, a few days preceding the deposition of eggs.

Both birds engage in hunting for a nest site, the site usually being near the headquarters of the territory.

The female builds the nest without the aid of the male, although the male is often in close attendance.

Eggs are laid at about twenty-four hour intervals.

Incubation most commonly begins with the deposition of the next to the last egg.

The female performs all of the incubation.

The male feeds the female just preceding and throughout incubation, providing about 80 per cent of her food.

During incubation the male defends the territory and especially the vicinity of the nest.

The incubation period is sixteen days.

The male does not feed the young up to the time that they are four days old but brings food to the female which is delivered by her to the young.

The eyes of the young open on the second and third days after hatching.

Pellets are spit up by young birds three days old.

The fear reactions of the young develop on the twelfth day.

Brooding is fairly continuous up to the eleventh or twelfth days.

The young do not decline in weight until they are sixteen days old.

Young normally leave the nest when about twenty days old.

Juveniles become independent of their parents at thirty-six days, but feed for themselves to some extent beginning with about the thirtieth day.

Song, impaling, and bathing instincts appear between the thirtieth and fortieth days.

Some pairs raise two broods in one season.

Song, on the part of the adults, is less abundant during the breeding season than during the late summer and early fall.

Food

The food of the American shrikes has received special treatment by Judd (1898) and by Beal and McAtee (1912). These treatises are based principally on stomach examinations conducted by the United States Bureau of Biological Survey. It does not appear necessary here to attempt to repeat, or even fully to review, the work of these authorities to the extent of listing all the kinds of food which they have found to be part of the diet of American shrikes. Through the courtesy of the Division of Food Habits Research of the Bureau of Biological Survey, Mr. Clarence Cottam has furnished a report of the stomach contents of sixty-three shrikes collected by me in California. These reports are of especial value since in many instances the type of habitat in which the bird was feeding at the time of collection is recorded in my notebook. The numerous published field observations pertaining to the food of shrikes are of value chiefly as they concern vertebrate animals and large sized insects which either may be seen readily by the observer or may be found impaled. Most field observations do not identify adequately the remains of small insects taken as food.

From an inspection of the reports of stomach contents of birds collected by me and from my own field observations, I am inclined to believe that shrikes possess an almost indiscriminate taste for all sorts of animal matter. That is to say, if food properly attracts the attention of a shrike and if it is within the shrike's power to obtain it, there are few kinds of animals that are rejected because of unsuitable flavor or consistency. For example, millipeds and beetles which possess odors obnoxious to human beings are eaten by shrikes, although perhaps without relish. Many varieties of food will serve to sustain adult

captive shrikes. My cage birds will live indefinitely on steak only or will thrive on a pure diet of rodents. Young birds were raised with fair success on earthworms which rarely, if ever, are eaten normally by shrikes. The shrike is an opportunist, living on the most abundant and readily obtainable supply of animal food. Thus, if an infestation of a certain species of insect takes place, the shrike follows the path of least resistance and feeds upon this insect (Bryant, 1912, p. 19), provided this source of food occurs within its sphere of activity. Such seasonal variation in diet as exists appears to be due to variation in food supply, not to a marked change in food preference as is noted in many species of fringillids which alternate seasonally between insectivorous and graminivorous food habits.

Lanius excubitor

Judd (*loc. cit.*) shows that from December to April the ratio of vertebrate to invertebrate food is 77 per cent to 23 per cent. In contrast to this, in October and November the ratio is nearly reversed, being 27 per cent vertebrate to 73 per cent invertebrate. Little is known concerning the food of the species while on the breeding grounds, but Grinnell states (1900, p. 55) that in Alaska on the breeding grounds, lemmings and meadow mice commonly are captured.

Mammalia.—Rodents constitute 22 per cent to 46 per cent of the food at times when 77 per cent of the food consists of vertebrate animals. Common among the genera recorded are: *Microtus*, *Lemmus*, *Peromyscus*, and *Reithrodontomys*.

Aves.—Birds make up 31 per cent to 55 per cent of food at times when 77 per cent of the food is vertebrate material. A list, by no means complete, of species recorded in the literature as captured includes: *Zenaidura macroura*, *Dryobates villosus*, *Dryobates pubescens*, *Sayornis phoebe*, *Otocoris alpestris*, *Passer domesticus*, *Loxia leucoptera*, *Calcarius* sp., *Acanthis linaria*, *Plectrophenax nivalis*, *Spizella monticola*, *Spizella pusilla*, *Spinus tristis*, *Spinus pinus*, *Junco* sp., *Richmondena cardinalis*, *Melospiza* sp., *Carpodacus cassinii*, *Vireo* sp., *Penthestes atricapillus*, *Baeolophus* sp., *Psaltriparus minimus*, *Regulus satrapa*, *Dendroica coronata*, and *Turdus migratorius*.

Reptilia.—An occasional snake or lizard may be taken, but the scarcity or absence of reptiles throughout the range of this species precludes the common appearance of reptiles in the diet.

Beal as quoted by Judd (1898) reports an instance of *L. excubitor* feeding on carrion in January at Ames, Iowa.

Orthoptera.—Members of this group amount to 24 per cent to 50 per cent of the food, thus comprising nearly the entire bulk of the food classed as invertebrate. The other invertebrates which are taken, although small in bulk, in some cases represent a large number of individual animals. Beetles constitute about 3 per cent of the food; many of these beetles belong to the families Carabidae and Cicendelidae. Larval lepidoptera, diptera, hymenoptera, myriapoda, and spiders are taken usually only in small quantities.

Lanius ludovicianus

Judd shows that vertebrate food may amount to as much as 76 per cent of the diet during the winter months, but during the remainder of the year it is only 28 per cent of the total food taken. Many of the specimens which were used to compile Judd's averages for winter birds were collected in the eastern United States. It will be seen from the samples of the stomach contents listed herewith that *gambeli* in winter probably never takes as much as 70 per cent of vertebrate food. Both Judd, and Beal and McAtee have mentioned the fact that *gambeli* seems to take fewer birds and mammals than do the eastern races. This is believed to be due to a more constant supply of insects throughout the year in the range of *gambeli* in California. Beal and McAtee estimate that vertebrate food during the entire year amounts to only 12 per cent in the western races, principally *gambeli.*

Mammalia.—Small mammals constitute 3 per cent to 55 per cent of the food, dependent on the locality and season. Some of the genera reported are: *Peromyscus, Microtus, Mus, Reithrodontomys, Perognathus, Dipodomys* (*nitratoides*), and *Sorex.* Fewer of the large sized members of *Microtus* and *Peromyscus* are taken by this species than by *L. excubitor. Reithrodontomys, Mus,* and *Perognathus* (the smaller species), where these forms are available, appear more commonly than larger rodents in the diet. Although in the eastern United States many more small mammals are taken in winter than in summer, this does not appear to be true of *gambeli.* In the San Joaquin Valley of California small rodents occur in the stomachs of shrikes more commonly during late summer than in winter. At this season there is a flux in the populations of *Reithrodontomys* and

Perognathus in California. It has been noted that *gambeli* taken about alfalfa fields, grain fields, and orchards usually have captured no mice. Contrasted with this are shrikes procured in areas in the San Joaquin Valley where the sparse native brush is undisturbed, more small rodents having been taken by the shrikes in these localities. Such regions, likewise, prove most profitable so far as numbers of mice are concerned when trapped by the mammalogist.

Hoxie (1889, p. 72) reports the killing of a full-sized cotton rat by this species in South Carolina. I know of no instance of *L. ludovicianus* killing an animal of any greater size. Hoxie believed, however, that the killing of the rat was partly accidental, a particularly fortunate blow with the beak causing death, and that the shrike had been startled by the size of the animal once it had attacked it.

Aves.—Birds at no time comprise more than 15 per cent of the food. Species known to have been killed include: *Chamaepelia passerina, Lophortyx* (young), *Gallus domesticus* (young), *Chaetura pelagica, Dendroica coronata, Passer domesticus, Plectrophenax nivalis, Ammodramus savannarum, Zonotrichia albicollis, Zonotrichia leucophrys, Zonotrichia coronata, Spizella passerina, Melospiza melodia, Carpodacus mexicanus, Serinus canarius, Vireo bellii, Penthestes* sp., and *Polioptila caerulea.* Many of the species listed are captured but rarely. Several authors report, nevertheless, the killing of *Passer, Ammodramus, Spizella,* and *Carpodacus,* and there are innumerable instances of attacks upon tame canaries.

A captive shrike was unable to cope with an English Sparrow, possibly owing to a marked abnormal deficiency in wing power on the part of the shrike. When presented with dead birds, of which they eat sparingly, captive shrikes experience great difficulty in removing the feathers. Mice are handled much more effectively than birds.

Reptilia.—In regions where reptiles are common, these animals appear to be taken in larger amounts than the 7 per cent or 8 per cent which Judd estimates is eaten by the species as a whole. Through much of the southwestern part of the range of *L. ludovicianus* reptiles are of decidedly more importance in the diet than are birds. Some of the forms recorded as eaten or impaled are: *Anolis carolinensis, Uta* sp., *Holbrookia* sp., *Sceloporus* sp., *Cnemidophorus tessellatus, Phrynosoma, Gerrhonotus scincicauda, Diadophis,* and *Thamnophis.* Snakes as long as eighteen inches may be successfully attacked.

Amphibia.—A few instances of impaled *Hyla* have been noted by me, and Judd mentions the capture of tree toads and frogs.

The poison secreted by the skin of *Batrachoseps* proved extremely distasteful to cage birds, and when these salamanders were fed to nestlings, the young became violently sick.

Pisces.—Minnows were recorded by Judd as constituting the entire stomach contents of a bird captured during winter in Utah.

Orthoptera.—Members of this group are variously estimated as constituting from 30 per cent to 75 per cent of the total food. Beal and McAtee differentiate between the eastern and western populations as follows: 39 per cent throughout the year in the eastern United States; 43 per cent throughout the year in the western United States. The higher percentages recorded for insects of this order occur at the times of year when grasshoppers increase to plague proportions.

Bryant (*loc. cit.*) concluded that grasshoppers at Los Banos, California, reached an abundance of twenty to thirty per square yard during a plague in July, 1912. At such times California Shrikes were found to eat 47 per cent of grasshoppers alone. He further states that the "birds changed their food habits and fed on grasshoppers, the insect most available" in the case of this outbreak.

Aside from the many species of grasshoppers and locusts preyed upon by *L. ludovicianus* should be mentioned the *Gryllidae* and *Stenopelmatus*. In California, *Stenopelmatus* is eaten particularly during the rainy season when it may be encountered frequently in fields or pasture lands. In winter this type of insect appears partly to take the place of the large numbers of grasshoppers which are eaten in the summer and fall months.

Coleoptera.—Members of this order combined comprise only 20 per cent of the bulk of the food but are represented by a large number of individual animals. Of the 20 per cent, the Carabidae contribute 7 per cent. On the other hand, many Scarabaeidae and Silphidae also are taken.

Lepidoptera.—Beal and McAtee report an occurrence of 4 per cent to 7 per cent for members of this order, the western shrike populations taking the greater percentage. Much of the lepidopterous food consists of larval stages. Some imagoes, however, are captured. Moths of many varieties are relished by the cage birds.

Hymenoptera.—Beal and McAtee report as high as 11 per cent of hymenopterans in birds from the western United States contrasted with 3 per cent eaten by shrikes in the eastern United States. I have noted numbers of impaled *Bombus* and have fed several to captive shrikes. Ants are not relished by cage birds.

Other groups of insects which occasionally are eaten, but seldom in large quantities, include many of the remaining orders under the Class Insecta: Ephemerida, Odonata, Isoptera, Hemiptera, Homoptera (*Okanagana*), and Diptera.

Myriapods and spiders, particularly the latter, in some individuals' stomachs constitute 30 per cent to 40 per cent of the contents. There are rare instances on record of the remains of gastropods and crustacea having been found in stomachs of Loggerhead Shrikes. Snails and slugs are not eaten by cage birds, but the isopod *Porcellio* is taken with much enthusiasm. Carrion eating has been reported in *L. ludovicianus* by Lloyd (1887, p. 295).

The vegetable material that is found in the stomachs of American shrikes of either species in a large part is known to come from the digestive tracts of various graminivorous prey. Vegetable material may amount to as much as 18 per cent of the stomach contents in some instances. Mr. Cottam, in examining the stomachs that I submitted to him, has endeavored to eliminate such vegetable material from the calculations of the percentages of foods eaten by shrikes. In addition to this vegetable matter ingested with the prey, however, plant food amounting to 2 per cent to 3 per cent may occur which appears to have been taken voluntarily by many of the shrikes. Most of the vegetable material is unidentifiable débris, but in one instance seeds of *Festuca* sp. and of *Erodium* were identifiable. I have failed to note shrikes in the wild taking vegetable food but have been successful in feeding moderate amounts of fruit, lettuce, and elderberries to captive shrikes. A captive juvenile once ingested a large number of the needles of *Sequoia sempervirens,* a branch of which had been placed in its cage. The needles of this tree failed to digest and later appeared in a pellet.

Ingestion of gravel to the extent of 1 per cent to 2 per cent of the stomach contents is not rare, but the majority of shrike stomachs completely lack inorganic material. It is probable that gravel is obtained by accident when food is broken to pieces and eaten on the ground. Cage birds obtain sand in this way. Shrike feathers occasionally are found in the stomach.

Representative samples of stomach contents of *gambeli* and *nevadensis,* as reported by Mr. Cottam, with additional notations concerning habitat are as follows. The quantities of organic materials are estimated on the basis of 100 per cent. The amount of gravel is in addition to the organic material and denotes percentage of total stomach contents, the organic material making up the remainder of the contents.

No. 2256, field number, E. R. Hall, June 11, 1928. Fish Lake, Esmeralda County, Nevada.

Condition of stomach: ¾ full.

Percentage of animal matter, 85; of vegetable, 15; of gravel, etc., 5.

Contents: Bone fragments of small Fringillidae, 9 per cent; fragments of 1 lizard, possibly a *Uta* sp.?, 15 per cent; fragments of 1 Acrididae, 1 per cent; fragments of 2 *Notoxus* sp., 2 *Coniontis* sp., 1 *Eleodes* sp., 1 Carabidae, 1 Scarabaeidae, 1 Staphylinidae, and other Coleoptera, 49 per cent; fagments of 1 *Sphenophorus* (*vomerinus?*), 8 per cent; fragments of 2 *Monomorium* and other Hymenoptera, 1 per cent; fragments of Lepidopterous larvae, trace; small mandible of 1 Myrmeleonidae, trace; fragments of 2 *Eremobates* sp. (mandible), 2 per cent; fragment of 1 Scorpionida, trace; plant fiber and wood pulp, 15 per cent.

Juvenal *nevadensis*, ready to leave nest in grove of *Lepargyrea argentea;* surrounding terrane nearly barren of vegetation; two hundred yards distant a small marshy area with short sedge grass.

No. 653, A. H. Miller, July 29, 1929. 3 miles northwest of Fairmont, Los Angeles County, California.

Condition of stomach: full.

Percentage of animal matter, 100; of vegetable, trace; of gravel, etc., 0.

Contents: Flesh, bone, and feather remains of juv. *Carpodacus m. frontalis*, 65 per cent; fragments of 1 small lizard, 2 per cent; fragments of 4 Acrididae, 8 per cent; fragments of 2 Tenebrionidae, 9 per cent; fragments of Carabidae, trace; Coleopterous débris, 2 per cent; pinchers of scorpion (Vejovidae?), 1 per cent; fragments of 10 or more *Camponotus* sp., 7 per cent; fragments of 15 or more *Solenopsis molestum*, 2 per cent; fragments of 1 *Agapostemon* sp., 1 per cent; fragments of 1 Psammocharidae, 2 per cent; Hymenopterous débris, 1 per cent; plant tissue, trace. 1 Shrike feather.

Juvenal *nevadensis*, out of nest, feeding on impaled hindquarters of *Carpodacus mexicanus frontalis* at 10:00 A.M. in open grove of Joshua trees; small scattered artemisia bushes beneath trees; juvenile begging from parent bird.

No. 696, A. H. Miller, August 5, 1929. Pond, Kern County, California.

Condition of stomach: ⅗ full.

Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 0.

Contents: Trace of rodent hair; scales and skin of 1 *Cnemidophorus tessellatus?*, 12 per cent; Coleopterous fragments, 1 per cent; fragments of 1 Acrididae, 33 per cent; fragments of 2 *Gryllus assimilis*, 54 per cent.

Adult *nevadensis*, shot from telephone pole over cotton field at about 11:00 A.M.; nearby were a small patch of atriplex brush and fields almost devoid of grass (dry).

No. 680, A. H. Miller, August 3, 1929. 9 miles north of Grapevine Cañon, Kern County, California.
Condition of stomach: full.
Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 2.
Contents: Fragments of 1 *Uta* sp., 68 per cent; fragments of 1 *Gryllus assimilis*, 3 per cent; fragments of 1 or more Buprestidae, 11 per cent; fragments of 1 *Sphenophorus pertinax*, 9 per cent; fragments of Carabidae, 1 per cent; Coleopterous débris, 2 per cent; fragments of 1 *Mutilla* sp., 6 per cent; fragments of spider, trace.

Adult *nevadensis*, shot about 12 M. from telephone wires over barren gravelly ground with scattered bushes two feet in height; alfalfa fields and sand dunes with stunted mesquite bushes two hundred yards distant.

No. 689, A. H. Miller, August 4, 1929. 4½ miles southwest of Wasco, Kern County, California.
Condition of stomach: ½ full.
Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 0.
Contents: Fragmentary remains of 1 *Cnemidophorus tessellatus?*, 93 per cent; Acridid fragments, 3 per cent; fragments of 1 dragon fly (mandibles), 1 per cent; mandibles of ant, trace; fragments of Buprestidae, 1 per cent; fragments of 1 Silphidae and 1 Carabidae, 1 per cent; insect débris, 1 per cent.

Adult, intergrade between *gambeli* and *nevadensis*, shot about 5:00 P.M. near alfalfa and cotton fields; virgin brush lands in near vicinity.

No. 694, A. H. Miller, August 5, 1929. 5 miles south of Corcoran, Tulare County, California.
Condition of stomach: full.
Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 0.
Contents: Fragments of Orthoptera, 2 per cent; fragments of 3 *Okanagana* sp., 90 per cent; 220 eggs *Okanagana* sp., 8 per cent.

Adult, intergrade between *gambeli* and *nevadensis*, shot about 2:00 P.M. from telephone wires over field with short dry grass.

No. 698, A. H. Miller, August 6, 1929. 2 miles east of Mendota, Fresno County, California.
Condition of stomach: full.
Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 2.
Contents: 1 tooth of *Perognathus* sp., 1 per cent; scales and bone fragments of 1 *Uta* sp., 1 *Sceloporus* sp.?, and 1 undetermined lizard, 43 per cent; fragments of 11 Acrididae, 30 per cent; fragments of 1 *Gryllus assimilis*, 4 per cent; fragments of Carabidae, trace; fragments of 1 *Dinocleus pilosus*, 13 per cent; fragments of 29 *Solenopsis molestum*, 2 per cent; fragments of 1 Eupelminae, 1 Pteromalidae, 2 Chalcididae, 1 Sphecidae, and 1 Figitidae, 1 per cent; fragments of 3 *Lasius* sp., 1 per cent; fragments of 4 *Camponotus* sp., 2 per cent; fragments of 2 *Thyanta* sp. and 2 Lygaeidae, 3 per cent; undetermined insect fragments, trace.

Plant tissue which appeared to come from the stomachs of the Orthoptera, amounted to 11 per cent of the total stomach contents and was not figured in the above percentages.

No. 700, A. H. Miller, August 6, 1929. 8 miles west of Kerman, Fresno County, California.

Condition of stomach: ⅗ full.

Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 1.

Contents: Fragments of 4 Acrididae, 54 per cent; fragments of undetermined lizard, 2 per cent; fragments of 1 Buprestidae, 2 per cent; fragments of 3 *Camponotus* sp., 1 per cent; fragments of 1 or more *Dinocleus pilosus*, 40 per cent; larval fragment of Tenebrionidae, 1 per cent.

No. 704, A. H. Miller, August 6, 1929. 7 miles west of Kerman, Fresno County, California.

Condition of stomach: nearly full.

Percentage of animal matter, 99; of vegetable, 1; of gravel, etc., 1.

Contents: Fragments of lizard (undetermined), 3 per cent; fragments of 9 Acrididae, 35 per cent; fragments of 1 Mantidae, 1 per cent; fragments of 2 *Hippomelas* sp., 41 per cent; fragments of 1 *Silpha ramosa*, 1 per cent; fragments of Tenebrionidae, 1 per cent; Tenebrionidae larvae, 1 per cent; fragment of Curculionidae, 2 per cent; fragments of 1 *Bombus* sp., 10 per cent; fragments of 6 *Solenopsis molestum*, 1 per cent; fragments of 4 *Myrmica rubra*, 2 per cent; fragments of 1 spider, trace; mandible and stinger of scorpion, 1 per cent; 1 seed of *Cyperus* sp. and other plant fiber, 1 per cent.

No. 704a, A. H. Miller, August 6, 1929. 7 miles west of Kerman, Fresno County, California.

Pellet.

Percentage of animal matter, 97; of vegetable, 3; of gravel, etc., 1.

Contents: 1 small badly worn feather, probably not a shrike, 1 per cent; fragments of 1 *Uta* sp., 3 per cent; remains of 1 *Perognathus longimembris*, 55 per cent; fragment of 1 *Gryllus assimilis*, 1 per cent; fragments of 7 Acridids, 4 per cent; fragments of 1 Mantidae, trace; fragments of 2 *Silpha ramosa*, 5 per cent; fragments of 1 *Eleodes* sp. and 2 other Tenebrionidae, 7 per cent; mandibles of Tenebrionidae larvae, trace; fragments of Carabidae, 4 per cent; fragments of 1 Curculionidae, 3 per cent; fragments of 2 *Hippomelas* sp., 8 per cent; fragments of 10 *Solenopsis molestum*, 1 per cent; fragments of 5 *Myrmica* sp., 10 per cent; fragments of 4 *Monomorium* sp., 1 per cent; fragments of 1 *Halictus* sp., 1 per cent; fragments of Ichneumonidae, 2 per cent; fragments of 1 Psammocharidae, trace; Hymenopterous débris, trace; fragment of moth, trace; fragments of 1 Vejovidae, trace; fragment of spider, trace; fragment of Myrmeleonidae, trace; 2 seeds of *Lepidium* sp., trace; 5 leaflets (undetermined) and other plant tissue, 3 per cent.

704a, the material from pellet picked up beneath perch of bird no. 704. Nos. 698, 700, and 704 all immature *gambeli* shot from telephone wires along an alkali flat; occasional patches of short dry grass and salicornia.

No. 705, A. H. Miller, August 7, 1929. 1 mile south of Firebaugh, Fresno County, California.

Condition of stomach: full.

Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 0.

Contents: Partial remains of 1 *Reithrodontomys* sp., 56 per cent; fragments of 1 Acrididae, 13 per cent; fragments of 2 *Gryllus assimilis*, 5 per cent; fragments of Buprestidae, 1 per cent; fragments of Carabidae, 1 per cent; fragments of 1 *Amara* sp., 1 per cent; fragments of 1 Sphecoidea, 2 per cent; Hymenopterous débris, 1 per cent; fragments of 2 *Okanagana* sp., 20 per cent.

Adult *gambeli*, shot at 12:00 M. from telephone pole near irrigation ditch; surrounding terrane included willows, tules, and sedge on ditch bank, stubble field, field planted to tomatoes, and barren alkali flat with salicornia, devil grass, and clumps of atriplex bushes.

No. 721, A. H. Miller, November 29, 1929. 4 miles north of Eugene, Stanislaus County, California.

Condition of stomach: full.

Percentage of animal matter, 99; of vegetable, 1; of gravel, etc., 0.

Contents: Fragments of 13 Acrididae, at least one of which was *Melanoplus* sp., 33 per cent; fragments of 4 *Gryllus assimilis*, 11 per cent; fragments of 3 *Stenopelmatus* sp., 11 per cent; fragment of Coleoptera, trace; fragments of 2 *Polistes* sp., 31 per cent; fragments of other Hymenoptera, 1 per cent; fragments of 2 or more *Chlorochroa sayi*, 7 per cent; plant tissue, 1 per cent; fragments of spider, 5 per cent.

First-year *gambeli*, shot at 11:00 A.M. from fence; surrounding terrane low, bare hills covered with sparse dry grass and weeds six inches high.

No. 722, A. H. Miller, November 22, 1929. 6 miles west of Firebaugh, Fresno County, California.

Condition of stomach: nearly full.

Percentage of animal matter, 99; of vegetable, 1; of gravel, etc., 0.

Contents: Fragments of Acrididae, 1 per cent; fragments of 1 *Amara insignis*, 1 *Amara* sp., 1 Tenebrionidae and other undetermined Coleoptera, 28 per cent; fragments of 5 or more *Chlorochroa sayi*, 63 per cent; fragments of 1 Helomyzidae, 6 per cent; fragments of 3 *Solenopsis* sp., 1 per cent; vegetable débris, 1 per cent.

No. 728, A. H. Miller, November 30, 1929. 1 mile south of Firebaugh, Fresno County, California.

Condition of stomach: ¾ full.

Percentage of animal matter, 100; of vegetable, trace; of gravel, etc., 0.

Contents: Fragments of 3 *Stenopelmatus* sp. (2 of these were nymphs), 10 per cent; fragments of *Amara insignis*, Tenebrionidae, and other Coleoptera, 23 per cent; fragments of 3 or more *Chlorochroa sayi*, 66 per cent; fragments of 2 *Solenopsis* sp., 1 per cent; other Hymenoptera fragments, trace; fragments of moth, trace; vegetable débris, trace.

No. 725, A. H. Miller, November 30, 1929. 13 miles west of Firebaugh, Fresno County, California.
Condition of stomach: ¾ full.
Percentage of animal matter, 100; of vegetable, trace; of gravel, etc., 0.
Contents: Fragments of 2 *Trimerotropis* sp., 78 per cent; fragments of 1 *Chlorochroa sayi*, 4 per cent; fragments of 2 spiders, 18 per cent.
The 2 per cent plant tissue was regarded as coming from the grasshoppers and was therefore not figured in the above.

Of the above three *gambeli*, the first two were taken in cotton fields, the last being collected in open grassy fields some distance from cotton plantations. *Trimerotropis*, a grasshopper, is found commonly in the dry grass at this season, whereas the weevil *Chlorochroa sayi* is common on the cotton and destructive to it. The degree to which diet depends on variation in the local supply of food may be noted by comparing relative proportions of grasshoppers and *Chlorochroa sayi* in the above three individuals. *Chlorochroa* ordinarily forms but a small part of the food of shrikes.

No. 487, A. H. Miller, February 4, 1928. Gilroy, Santa Clara County, California.
Condition of stomach: ⅔ full.
Percentage of animal matter, 99; of vegetable, 1; of gravel, etc., 7.
Contents: Fragments of Corixidae, 1 per cent; 10 larvae of *Tipula* sp., 45 per cent; 1 *Silpha ramosa*, 10 per cent; fragments of at least 6 *Hypera punctata*, 39 per cent; spider fragments, 4 per cent; plant fiber, 1 per cent.

No. 488, A. H. Miller, February 4, 1928. 15 miles south of San Jose, Santa Clara County, California.
Condition of stomach: ¾ full.
Percentage of animal matter, 99; of vegetable, 1; of gravel, etc., 2.
Contents: 26 *Tipula* sp. larvae (part of these were lost), 82 per cent; fragments of Coleoptera, 1 per cent; fragments of Diplopoda, 8 per cent; fragments of *Stenopelmatus* sp., 7 per cent; leg fragment of Hymenoptera, 1 per cent; plant tissue, 1 per cent.

The above two *gambeli* taken in fruit orchards with adjacent areas of plowed ground and short green grass.

No. 522, A. H. Miller, April 6, 1929. 3 miles east of Bay Point, Contra Costa County, California.
Condition of stomach: ⅔ full.
Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 0.
Contents: Fragments of 2 *Gryllus assimilis*, 97 per cent; egg fragments of *G. assimilis*, 1 per cent; fragment of 1 weevil (Curculionidae), 1 per cent; fragment of 1 spider, 1 per cent.

First-year *gambeli*, shot from row of eucalyptus trees; adjacent terrane, barren plowed field and grain ten inches high. The abundance of *Gryllus* in this vicinity in April and May has been noted frequently, the animals being killed on the roadways in considerable numbers.

No. 527, A. H. Miller, June 8, 1929. 2 miles south of Rodeo, Contra Costa County, California.
Condition of stomach: nearly full.
Percentage of animal matter, 100; of vegetable, trace; of gravel, etc., 0.
Contents: Fragments of 10 Locustidae and 1 Acrididae, 60 per cent; 90 Locustid eggs, 17 per cent; fragments of 1 *Melanotus* sp. and 1 other Elateridae, 23 per cent; fragments of plant tissue, trace.

No. 528, A. H. Miller, June 8, 1929. 2 miles south of Rodeo, Contra Costa County, California.
Condition of stomach: ⅜ full.
Percentage of animal matter, 98; of vegetable, 2; of gravel, etc., 0.
Contents: Rodent hair and small bone fragments, 10 per cent; 1 Conocephalinae, 69 per cent; 23 eggs of the same Locustidae, 12 per cent; fragments of Carabidae and other Coleoptera, 7 per cent; plant tissue, 2 per cent.

No. 529, A. H. Miller, June 8, 1929. 2 miles south of Rodeo, Contra Costa County, California.
Condition of stomach: full.
Percentage of animal matter, 100; of vegetable, 0; of gravel, etc., 0.
Contents: Fragments of 3 Locustidae, 40 per cent; 38 eggs of same, 10 per cent; fragments of bones and hair of rodent, 1 per cent; fragments of 5 Chrysomelidae larvae, 1 per cent; fragments of 1 *Necrophorus marginatus*, 48 per cent.

The above three, a family group of *gambeli* consisting of adult female (no. 527) and two fully grown juveniles still receiving food from adults; all three taken at 3:00 P.M. from scattered group of white oaks on steep hillside covered with grass twenty inches high.

The food of nestling Loggerhead Shrikes apparently is not different from that of the adults except during the first three or four days when some of the larger prey ordinarily captured by the adults could not possibly be ingested by the young. It may be recalled, however, that a grasshopper femur nine millimeters long was given to young two days old by the parents of the brood which later was raised in captivity.

In summarizing the factors which govern the kinds of food eaten by shrikes, I would mention first the factor of the size of prey. Animals which are too small to compensate for the energy expended by a shrike in procuring them mark the lower limit of size. The maximum size of prey is determined by the limits of the powers of the shrike to overtake and kill large sized animals. When large animals are available, these perhaps are preferred to smaller animals since one or two captures with the aid of the impaling reactions may provide food for an entire day. Secondly, in any habitat at any particular season there exist one or more optimum types of prey, that is to say, animals which by reason of their abundance in the habitat and

the efficiency with which they may be captured are most commonly used as food. Obviously, the efficiency with which food is captured in turn depends on a delicately adjusted equilibrium between the many protecting devices on the part of the prey and the detecting powers of the shrikes. More will be stated later concerning the shrike's methods of detecting food.

The differences in the diet of the various subspecies within a species, which differences unfortunately are incompletely known, suggest that these are correlated with variations in habitat but not with any inherent variation in choosing on the part of the shrikes.

The difference in diet that exists between the two American species, however, is of relatively greater magnitude than the subspecific differences within either species and probably is due to responses of longer standing to the general differences in the environments to which the two species have been subjected. When the two species are thrown into similar habitats, as occasionally occurs in winter, psychical or structural differences dictate a relatively higher per cent of vertebrate food, especially birds, in the case of *L. excubitor*, the more boreal species. In the northern latitudes, among land animals, lower temperatures result in homoiothermic forms, birds and mammals, being a relatively more constant food supply than poikilothermic insects and reptiles. It is not surprising, then, to find the more northern species of shrike the better adapted in its heavier beak and especially in its shorter, stronger metatarsus to a diet of higher vertebrates. The specific difference in diet therefore also appears to be correlated with environment, but the divergence between the species is sufficiently permanent that the diet is markedly different even when the two species are thrown together in the same region.

Foraging

The feeding territory of *L. ludovicianus* already has been considered, but there remain to be described those actions of the Loggerhead Shrikes which lead to the discovery and capture of their prey. The most profitable method of foraging, although not the one commonly observed, is what I have termed active hunting. This activity occurs usually in the early morning and at dusk in the evening. More excursions to the ground are made while engaged in this manner of foraging than in other forms of hunting. The actions as seen in *gambeli* consist principally of perching on objects from six inches

to six feet above the ground where prey clearly may be seen moving within a radius of a few yards. At times the ground or low bushes are resorted to and the bird hops about in these places in search of animals. The shrikes in moving rapdily from perch to perch fly close to the ground and as a result are difficult to observe. Instead of waiting indefinitely on a perch until prey is sighted, if food is not secured from a certain post within a minute or two, the bird moves on to another part of its territory. Much or all of the territory of a given bird may be covered in a short time as a result of these foraging tactics, although especially favorable localities detain the bird for relatively long intervals of time.

Contrasted with active hunting is what may be called passive hunting. This latter is noted commonly during a large part of the day at times other than when adults are engaged in feeding young. Passive hunting is conducted from relatively high perches which at the same time may serve as territorial lookout posts. Food is captured at distances from the perches of from ten to one hundred and fifty feet, and there are extended intervals, often ten to thirty minutes in duration, when no food is taken. During passive hunting it is believed that particularly desirable or obvious food is captured but that much of the food which must be present escapes observation from the higher perches, fails to elicit response in the well sated bird, or perhaps is so inactive during midday temperatures and light intensities as to escape detection. The passive form of hunting occurs when digestion and pellet formation are in progress, the results of the early morning active hunting. Birds which are collected while engaged in passive hunting rarely are found to lack a well distended stomach. In winter when the food supply is meager, active and passive types of feeding tend to merge one into the other and an intermediate degree of foraging activity prevails throughout the day.

Animals which are captured, it is believed, are located largely by the detection of their motion, either in the air or on the ground, but principally the latter. In captive birds any flying, crawling, or moving thing draws attention and usually pursuit. Thus, a dead mouse is far less exciting to a shrike than a live mouse. Moths or flies in the cage are pursued vigorously. In adults, until it is learned that a particular kind of inanimate object is edible, such an object is not often picked up in the bill. On the other hand, both captive and wild birds are curious and engage in a certain amount of inspection of stationary objects. Wild shrikes, as they hop about following

an unsuccessful trip to the ground in pursuit of moving prey, have been seen inspecting and probing plants and various inanimate objects. Immature birds, particularly, pick up and investigate the edibility of motionless things. One captive juvenile swallowed string and rubber bands which were lying in its cage, eventually disgorging them as pellets. Evidently, a shrike to some degree learns to recognize suitable food materials by "trial and error." However, anything that moves, rarely proves to be unsuitable food and an adult uses motion as the most reliable criterion of food. Disgorging is a convenient remedy in the case of a mistaken selection.

A less common method of foraging, a number of times reported and several times observed by me, is the capturing of insects in the air, the birds maneuvering as do kingbirds, though in an awkward fashion. Dragonflies are caught in this manner. The actions consist of darting out into the air at insects as they fly past, the shrike often towering many feet above its perch.

The flight toward prey on or near the ground commonly is a nearly vertical or diagonal plunge either with set wings or, if necessary, accompanied by rapid wing motion. Hovering frequently is observed at the end of the approach flight and is either a searching device or serves to allow the bird better to judge the succeeding stages in the attack. Shrikes are adept at following prey which may fly or run from them. They are aided in this by the short rapidly moving wings and long tail, which enable them to change rapidly the direction of their flight. The use made of the wings and tail is suggestive of the actions of the small, round-winged accipitrine hawks which, by reason of similar proportions, dodge about through bushes or trees in pursuit of small birds. Mentioned in the discussion of geographic variation of wing length is the seeming correlation of short wings with less open habitat, which habitats perhaps necessitate maneuvering in closer quarters than do the more open prairie regions.

If prey is large or dangerous, the shrike checks its own approach, hopping or hovering about and waiting for suitable opportunities to attack. Cage birds dance about with wings spread and tail fanned when hesitating in their attack on a large-sized animal. The worrying of prey which is difficult to kill is most persistent. Captive shrikes often spend half an hour at a time in attempting to kill large-sized mice and, failing in their efforts, will worry the mice at intervals during the greater part of a day. Wild shrikes are noted for the persistence with which they endeavor to conclude an attack upon an animal.

The initial thrust at prey is with the bill. The effective motion is not a pounding or driving action with the end of the beak but is a rapid biting motion of the tip of the lower mandible against the tomial tooth of the upper mandible. The killing mechanism, then, is a quick cut or snip of the bill. In the case of insects, prey is seized in the region of the thorax or head. In birds, mammals, or lizards the attack is directed at the back of the head or the neck. Wayne's report (1921, pp. 279, 280) of claw marks on the back of a phoebe captured by a Loggerhead Shrike is not conclusive in proving that the prey was killed by grasping with the feet. The first and successful efforts of captive juveniles to kill mice show a pronounced concentration of the attack on the anterior quarters of the prey. Adeptness of juveniles in killing mice is gained through successive experiences.

After the initial successful thrust with the bill, a series of rapid biting motions follow and sometimes also shaking or pounding of the prey against the ground or perch. In the case of large animals a shrike commonly stands motionless for several seconds, and often minutes, after the animal is dead before further disposing of its catch. This is rarely done when small insects are caught.

Impaling Instinct

Seebohm (1883, p. 594) explains that the impaling habit of shrikes is the result of a lack of sufficiently powerful feet to hold the prey while it is being torn to pieces, thorns or crotches being used in order to hold the food while it is being eaten. This is essentially the interpretation that I would put on this, the most characteristic, behavior of shrikes. Out of the fundamental need for a butchering mechanism, have arisen certain adjunct uses of the impaling instinct which have received undue emphasis at the hands of many writers. These auxiliary modes of behavior are the habits of storage and of wanton slaughter, and certain actions which have been interpreted by some popular writers as indicative of brutality.

Once a shrike has killed or injured its prey to the extent that it is incapable of escape, the food is further disposed of in one of two different ways: it is either impaled or else it is almost immediately eaten. If the food is smaller than about one centimeter in its greatest dimensions, it is swallowed at once or is taken to an elevated feeding or lookout post and there eaten. Occasionally, additional beating or biting of the prey may occur on the feeding post. Extremely elongate

animals which are small in diameter are handled similarly. The captive shrikes have shown a dislike for swallowing even small animals that still are moving. They have been seen to spit up small, partly swallowed insects that still were moving and further bite and break them to pieces. Small prey, as far as known, always is carried in the bill. Occasionally the feet are used to grasp small prey so as to obtain a fresh hold with the bill. The degree to which the foot is used in this way varies with individual shrikes. When food is held in one foot, the bird does not use that foot to support its weight. With the claws clenching the food the metatarsus is rested across a perch or against the ground. I have failed to note any instances of shrikes holding their prey against a perch or against the ground by standing on it as do jays and hawks. To peck at or tear at food in the foot, as occasionally is done, the shrike seems required by its structure to hold the foot forward of the position normally taken in perching.

The category of food which characteristically is handled as above described, that is, without impaling, may on occasion include larger objects if the shrike is disturbed and hurried in its actions by an intruder. At such times shrikes will attempt to gulp objects which distend their throats to the utmost, in extreme cases resulting in an audible gasping because of the partly closed respiratory passages. I have seen cage birds repeatedly attempt to ingest food which either they had failed to break up by impaling or feared would be taken from them, with the result that they were forced to disgorge. Several times, I have seen the foot used to extract objects which were stuck in the mouth. In these instances, the foot was not thrust into the mouth but passed along the side of the head, the claws catching hold of projecting parts of the food at the angle of the mouth.

Large objects which must be impaled before being eaten are carried, during flight, in the bill as a rule, but occasionally in the feet. There appear to be more records of *L. excubitor* carrying food in the feet than there are of *L. ludovicianus*. I have been so unfortunate as never to have seen prey being carried in the feet while in flight, but the number of recorded instances by thoroughly dependable observers indicates that this action does occur, although but rarely in *L. ludovicianus*. Esterly (1917, p. 25) reports the actions of a California Shrike as follows:

> The shrike flew against a window pane near where I was, and dropped a dead "White-crown." When the sparrow was picked up again it was seized by the neck, and the shrike flew off with it. But before it had gone more than a yard, and while about a foot in the air, the shrike released its hold on the neck of the

prey and, without hesitating or altering its course, caught the sparrow in its feet. The flight was continued for about fifteen yards, and then the shrike dropped to the ground. It started off at once and the same behavior was repeated; the prey was picked up by the neck with the beak and this hold was given up, while flying, for the hawk hold. The substitution is almost instantaneous; the burden does not drop perceptibly and the flight is continuous and steady.

This observation on behavior, although entirely reliable, must be considered as abnormal, for most shrikes certainly do not handle their prey in this fashion. Perhaps to preserve the balance of the bird in flight especially large prey is carried in the feet rather than in the bill. It is of interest to note in this connection that White-crowned Sparrows, *Zonotrichia leucophrys,* weigh approximately twenty-six grams, whereas the California Shrikes weigh about forty-eight grams. *Zonotrichia coronata,* one of the largest animals killed by *L. ludovicianus,* weighs on the average about thirty-two grams.

Large sized prey seldom is carried to feeding or lookout posts, since these places rarely provide facilities for impaling. Instead, shrikes resort to special impaling stations within the territory. The variety of impaling devices used by the shrike is great and indicates a generalization of the inherited reaction which permits of individual adaptability in the matter of finding and experimenting with the most effective means for the fixation of food. It is believed that the initial efforts of juveniles to impale best illustrate the behavior in its instinctive or generalized form uncomplicated by learned components. The first attempts at impaling have been noted in cage birds at the age of forty days. These attempts consist of dragging the food along the perches with a jerking motion, the head held low and the long axis of the bill paralleling the perch. If nails are provided in the perches, the food on encountering these obstacles offers resistance to the bird, which continues to tug and may on occasion thus firmly lodge the food on the nails. Subsequently, small bits are picked from the impaled mass, first gently, but later they are torn loose with great vigor. If the food becomes dislodged from the nails, impaling efforts are renewed at the location of the former successful impaling. If nails are not provided, the first efforts at dragging food along the perch being unsuccessful, juveniles attempt to wedge their food into corners or between the wires of the cage. This is done always by pulling objects over or through crevices and not by pounding them into such places. Thus, the initial inherited reaction is fairly complete in its first appearance. The feet are used to hold large prey

in order to gain a better grip with the bill. Occasional feeble efforts to tear at large prey held in the feet may follow unsuccessful efforts to impale, but this line of action never is followed for long. Adeptness in handling, in firmly fixing, and in the recognition of suitable impaling locations increases greatly with experience.

The impaling devices which shrikes in their varied habitats learn to use are impossible of complete treatment. Mortimer (1890, p. 342) mentions the common use of splintered pine stumps as impaling places in Florida. Various thorns or sharp twigs are used in most localities.

Fig. 64. Headless *Microtus dutcheri* impaled on willow snag by *Lanius ludovicianus nevadensis* at Whitney Meadow, elevation 9800 feet, Tulare County, California. Photograph taken August 10, 1911. Mus. Vert. Zool. no. 576.

Well-known examples of trees and plants used in this connection are: osage orange, orange, hawthorne, yucca, mesquite, atriplex, and some cactuses. The use of barbed wire is widespread wherever this is available. Ends of broken branches also are used extensively. I have observed a California Shrike slip the abdomen of a *Stenopelmatus* over a broken willow twig one-fourth of an inch in diameter, fitting it on tightly, and then proceed to tear off bits from the open proximal end of the abdomen. My cage birds became accustomed to impaling upon the split end of a small broken branch as well as upon nails driven through their perches. The impaling stations within a shrike's territory often are within a few feet of the ground, and in my experience seldom are found higher than fifteen feet.

IMPALING AS A MEANS OF STORAGE

If shrikes are hungry when large prey is impaled, enough is eaten to thoroughly gorge the shrike. As much as seven grams of food may be eaten at one feeding. If the impaled food amounts to more than this in bulk, the remainder may be left hanging. The shrike returns to the food during succeeding hours and usually eats it to the last morsel. As a storing device, impaling is useful for periods of a day or two only, unless climatic conditions favor the preservation of the animal food for longer intervals of time. In other words, a shrike eats its fill of the impaled object and leaves the remainder in place. Impaled objects are comparable to the kills of large predatory mammals, and, so long as they are still edible, the shrike returns to them unless more recent kills occupy its attention. Storage in its true form involves gathering together a considerable quantity of food for future use without at the time partaking of it extensively. The object of the American shrike's habit of impaling, then, is not truly storage. When concentration of impaled objects does occur it is due to the habitual return of the shrike to a successful impaling station because of the facilities available there for the ready handling of the prey, and not because of a desire to store or concentrate food. In inspecting numerous shrike impalings I find that where abundant impaling situations, such as barbed wire fences, are at hand, the unfinished meals of shrikes are distributed along such fences at considerable intervals. Concentrations of impalings such as often do occur probably result from a scarcity of impaling facilities in a territory. Cage birds, having filled one impaling post with food which has become dried and seemingly inedible, upon the presentation of more food do not attempt to add to previously impaled prey but seek new impaling posts where they may butcher their food undisturbed by the remains of previous operations.

The fact that, in winter, shrikes of both species have been known to feed on carrion, and also Watson's (1910, p. 459) report of *L. ludovicianus* in New Mexico feeding on exceedingly dry impaled lizards would seem to indicate that hungry shrikes on occasion can make use of the storage value incidental to impalings of long standing. The practical value to shrikes of impaled food older than a few days, nevertheless, is slight. Cage birds will become frantic with hunger after starving for an entire day or more but will refuse to eat dry meat or spoiled mice. Impaled animals that I have observed in the

field have been left untouched indefinitely by the shrikes if they were not eaten during the twenty-four hours following capture. A considerable portion of the deserted impalings consists of parts of animals which would seem to be less desirable as food. Jaws of lizards, the hard heads of *Stenopelmatus,* partly picked bones of mice, and the wings and tails of birds are samples of deserted parts which appear on the average more abundantly than do soft-bodied insects and the flesh of vertebrates. Recent, although deserted, impalings do not appear in the same abundance at all times of year in California. During the middle of winter they are rare and I have never found them where young or brooding females were being fed. The season of their greatest abundance is in the late summer and fall. Recent, deserted impaled animals on a fence at Pinole no. 4 were observed almost daily in the early spring of 1930 but ceased to be added to coincident with the beginning of the incubation period. The old dried pieces of impaled prey of the early spring were left untouched during incubation and while the young were being fed.

WANTON KILLING

The belief was expressed elsewhere that shrikes respond to the sight of any small moving animal by attacking it. An adult cage bird commonly captures animals, particularly if they are moving, even when it is too full to eat them. It is more rapid in its response to food when hungry but nevertheless it reacts almost always to the sight of additional food. This cage bird's reaction to food when not hungry is prolonged to include the impaling of the prey but then ceases, the impaled object being thereafter left untouched. These actions might seem to indicate killing or hunting with a view to storing but they are better interpreted merely as an uncompleted series of the ordinary feeding reactions, the failure to complete the reactions resulting from a well sated appetite. Food which has been impaled, but at the time was entirely uneaten, is less frequently returned to than food which was partly eaten immediately following capture.

The killing and impaling of animals subsequently unused as food has been spoken of as wanton killing or killing for pleasure. Speculations concerning "pleasurable" feelings in animals, however, prove futile. A shrike kills in response to external stimuli whether it is hungry or not, because certain mental urges are thereby satisfied. If one so desires this may be considered comparable to human sensations of pleasure, but to me the shrike appears to feed largely in a

mechanical fashion. The bird is so constructed that it must capture moving objects, and the intensity of this reaction is affected only to a moderate degree by actual hunger. Once the prey is obtained the next step in the chain of feeding reactions leads to impaling. Not until impaling is completed, in the event that the stomach is sufficiently full, does the anticipation of gulping unneeded particles of food lead to a checking of the succeeding stages in the chain of feeding reactions.

Thus, in American shrikes a potential storing mechanism exists which has arisen secondarily from a method of manipulating food. So-called stores of food are little used by these birds except over short periods of time. True storage as seen in rodents probably has failed to develop because the shrike's food, unlike that of graminivorous forms, is not readily kept in edible condition. Devices for preserving animal food in edible condition have not been discovered by shrikes. The "lust to kill" in excess of needs is to be looked upon as a purely automatic reaction involving none of the compunction which human beings hold concerning killing. Likewise, no sense of cruelty can be ascribed to a bird that obtains and handles its food largely in an instinctive manner. As a matter of fact, shrikes usually thoroughly kill their food before impaling it, except in the case of some insects which at times may be found moving their appendages feebly after being impaled.

Digestion

By preference food is swallowed in small pieces but also may be taken in capacity amounts. Food moves at once to the stomach or, if the stomach is full, is held for a short time in the lower part of the oesophagus. Young birds may be fed until the food in the upper oesophagus can be seen by way of the open mouth. Digestion of meat takes place rapidly. A captive bird which partly swallowed a long strip of meat later was forced to disgorge the entire mass. The lower end of the strip of meat which had been in the stomach approximately three minutes was light brown in color and the surface to the depth of one millimeter was softened and slightly corroded. Colored materials, such as elder berries, are found to pass the length of the digestive tract in about three hours.

In nestlings and adults alike, all manner of undigested material is disgorged in pellets including such objects as small particles of bone meal two-tenths of a millimeter in diameter. Materials undigested and

included in pellets are bones, some cartilage, ligaments and tendons occasionally, most hard parts of insects, reptile scales, hair, feathers, suet, hard vegetable matter, and a variety of inorganic materials. Pellets, as a rule, correspond roughly to the maximum size of the stomach but may vary from one to four centimeters in length and from one to one and one-half centimeters in diameter. They are roughly fusiform with tapering wisps of material at the ends. Fresh moist pellets are soft and readily broken apart but later they become dry and hard and crumble only if composed largely of small insect remains. Hard parts of insects and bones contained in pellets fail to show corrosion of their surfaces.

In ejecting a pellet a shrike first begins to gape, often twisting the head to one side and straightening the neck; then the bird either flips the pellet from the mouth with a shake of the head or works it out more slowly with the tongue. Pellets drop to the ground beneath the perch or, less commonly, may be carefully laid on the perch. Wiping of the bill invariably follows ejection. Immature cage birds have been seen picking up their own pellets and impaling them and tearing them to pieces.

Birds with stomachs empty of undigested material when fed on mice may eject pellets within two and one-half hours after feeding. About three hours is the average time required for digestion and the ejection of a pellet. The arrangement of the material in the pellets suggests that the food is kneaded by the stomach in a lateral direction since the longitudinal arrangement of materials roughly preserves the order in which the food was ingested. Following ejection birds experience hunger and beg, hunt, or seek impaled prey, in contrast to a period of pronounced inactivity in feeding just preceding ejection.

The amount of food eaten by captive birds, which compared with wild shrikes are relatively inactive, is between fifteen and twenty grams of beefsteak or mice in the course of a fifteen-hour day. A rough calculation of the gross metabolism of a six-months-old cage bird for a period of fifteen hours of daylight resulted as follows:

Ingested		*Eliminated or Gained*	
Mouse	12.5 g.	Feces passed	11.0 g.
Beefsteak	6.0 g.	Pellets	1.7 g.
		Gain in weight of bird	2.2 g.
Total	18.5 g.	Loss, supposedly by respiration	3.6 g.
		Total	18.5 g.

The weight gained was entirely lost during the succeeding nine hours of sleep. The amount of food necessary to maintain metabolism ir a forty-eight gram bird while inactive in a cage, although high, must be considerably less than the amount used by active wild birds.

Preening and Bathing

Preening in Loggerhead Shrikes involves no features that appear to be different from those pertaining to other passerines. The importance of the early inception of preening is discussed on page 185. The remiges and rectrices are preened by running the entire length of each feather, starting at the base, through the loosely closed mandibles. In preening the body plumage several feathers are worked at one time, a slight motion of the mandibles accompanying the drawing of the feathers through the bill. I have not discovered any regular sequence in preening the various parts of the plumage. Often preening consists of working over only a few of the body feathers, the large part of the plumage being left untouched. The feathers of the head and neck are scratched by placing the foot forward above the wing and vibrating the entire foot with great rapidity. An unproportionately large amount of time is spent in attending to the region of the oil gland. Usually the rump feathers conceal the gland so that one cannot see whether the bill touches the gland or not. Once while watching a cage bird which had just finished bathing and in which the feathers had become separated around the oil gland, I distinctly saw the bird seize the gland below the base of the papilla and press the mandibles together. Immediately following this, the bird preened a large area of its breast and one of its wings.

The amount of time spent during a day in preening is difficult to estimate. I have noted preening at all hours of the day and under a variety of conditions. The process certainly is stimulated by any wetting or soiling of the plumage. Preening increases in amount during molt.

Cleaning of the bill is an important and frequent occurrence, almost without exception following upon feeding. It also has been seen to occur in an automatic fashion in birds that have returned to their lookout perches, after failing to capture food or in any way touch their bills to other objects. Cleaning consists of a rapid whetting or wiping of the sides, the motion being in the direction of the length of the bill. The head is thrust downward, first on one side of the

perch and then on the opposite side in nearly regular alternation. Cleaning of the bill in juveniles, which begins at the age of thirty-three days, at first is a feeble, deliberate action but in form is similar to the action in the adults.

Bathing, which starts instinctively at about the age of thirty days, is performed once a day and occasionally twice a day by captive shrikes. In the wild, where water is available, bathing probably is indulged in similarly. I have seen *gambeli* bathe in a pool of rain water two inches deep. The plumage is well wet in a manner commonly noted in other passerines. Preceding bathing, and while looking at the water obviously with a sense of anticipation, the wings and tail are fluttered and rattled as though they already were wet. Before entering the water the bird hops about and may bob the head in a nervous manner. Two or three separate trips to the water may be made at intervals of a few minutes, between which trips the bird partly dries its feathers and preens. The benefits derived from bathing must be appreciable in order to compensate for the dangers undergone through the temporary impairment of flight power while the bird is wet. A bird that had just completed a bath in a shallow pond in a field was chased about by me over the field for several minutes before its remiges dried sufficiently to permit it to rise to perches twenty feet in height. Vigorous shaking and trembling of the wings often continue for fifteen minutes after a bath.

Included under this section should be mentioned stretching, particularly that of young birds. Immatures, and less frequently adults, at times rise high on their legs and tip the body forward, holding the wings up over the back. Also, they may stand on one leg and thrust the other leg, with foot closed, backward beneath the partly extended wing of the same side. Immatures have been seen to hold fast to their perches and, violently fluttering the wings, lift themselves up, stretching their legs to full length. This is accompanied by a staccato clucking note. Shrikes occasionally yawn, somewhat elevating the upper mandible as well as depressing the lower mandible.

Modes of Progression

Loggerhead Shrikes hop but do not walk. In moving sideways or backward one foot is moved independently of the other. While hopping, the body is held erect and the head high unless the bird is engaged in investigating objects close to the ground. When hopping in dense trees or bushes, the bird lowers and thrusts forward its head,

the body being held nearly horizontal. Birds in open terrane when alarmed may fly to the ground rather than to bushes or trees and hop about or stand with head held high in order to watch for danger.

The American shrikes have two principal modes of flying. One type consists of an abrupt drop from a perch, followed by a low, even flight close to the ground and an abrupt rise to the succeeding perch. That is, the line of flight is below the level of the perches and without vertical undulations. The ascent at the end of the flight is gradual if perches are more than fifteen feet in height. The second type of flight is performed higher above the ground, often as high as twenty feet, frequently is undulating, and commonly is used in covering greater distances than is the low type of flight. These two kinds of flight may merge one into the other. Juveniles younger than forty days do not undulate in flight. Variations have been noted in the length of the vertical flight undulations in different individuals. The male at Pinole no. 6, supposedly with relatively longer wings, performed longer, deeper undulations than did his mate.

My own estimates of total distances traveled daily by resident Loggerhead Shrikes during summer vary from twenty to forty miles, depending on the size of the feeding territory. Wetmore (1916, p. 112) gives the speed of flight of *gambeli* as twenty-eight miles an hour. Consequently, it would seem that shrikes spend most of the day sitting or engaged in other activities not involving flight; a total of only one or two hours daily is spent on the wing.

The nuptial, juvenal, and foraging flights are described in other sections of this paper.

VOCAL NOTES

Most of the utterances of Loggerhead Shrikes already have been described, but they may appropriately be reviewed here. It has proved difficult or impossible adequately to represent the songs phonetically. This therefore is not attempted. The spring song of the male consists of short trills or combinations or clear notes repeated a number of times, yet varied in rhythm, pitch, and quality. For example, each of the separate parts or units of the song may be primarily a trill with three or four distinguishable throbs in it. The quality of the trill often is described as liquid but the trill also contains harsher, burred qualities. Added to this trill are clear, usually sharp, descending or ascending terminal notes. Other songs lack a trill, two or three clear or burred notes, variously accented and

pitched, constituting the unit of song. Still other individuals precede a trill by clear notes. The most characteristic features of the Loggerhead Shrike's song are not pitch or the structure of the unit song of a series, but rather the rhythmic repetition of song units and certain general tonal qualities impossible of description or even exact imitation. The units of song are repeated at an average of one every two seconds but the rhythm may be more rapid if the song unit is especially short.

The feeding territory song of *gambeli* given in summer by males and females alike is of the same general construction as the spring song but appears to contain fewer high clear notes and more notes rough in quality which resemble the quality of the harsh screeches or begging notes.

Immature birds give a decidedly different song of a continuous sort, consisting of short screeches, gurgles, trills, and clear notes in a succession which is pleasing to the human ear. This song is to be likened to the musical efforts of jays of the genus *Cyanocitta.* I have heard only immature cage birds and one immature wild bird give this song. It is frequently full-toned but perhaps typically is a "whisper song" or primitive song (Saunders, 1929). The bill occasionally is slightly parted as in the delivery of the spring song.

The songs of the American *excubitor* all appear to be similar in composition to the continuous type of song of immature *L. ludovicianus.* There are no reports which indicate that *L. excubitor* possesses a rhythmic song comparable to that of the Loggerhead Shrike. Other notes of *excubitor* are said to be similar to those of *L. ludovicianus.*

It is the continuous type of song which has led observers to claim that shrikes imitate other birds. However, I have consistently failed to detect anything in these songs that could definitely be called imitation. Captive juveniles which never had heard songs of other birds or of shrikes uttered primitive songs identical with those given by wild shrikes. Such songs of cage birds are purely instinctive and unlearned.

The screech or call note consists of from four to ten or more harsh forceful utterances of progressively diminishing intensity, the first notes slightly higher pitched and shorter than the terminal notes although pitch is difficult to detect in a sound so thoroughly discordant. A metallic variation of this call note occurs during nuptial displays.

Single notes, *schgra-a-a,* of a quality less sharp than that of the screeches, variously repeated and resembling the more husky notes of *Cyanocitta stelleri,* are given by birds while defending their nests. These notes are each longer in duration than a single screech of the call note series. This type of note also may be given while a Loggerhead Shrike is worrying prey which it cannot readily kill.

The staccato clucking notes, heard during attacks upon invaders or when birds are in a defensive attitude, appear to have been overlooked by many observers.

The pulsating or begging notes of young and the begging notes of adults are extremely similar although slight differences in quality may be detected. The *tsp* and *tcheep* of young in the nest, fear notes of juveniles, the juvenile's "location note," *screig,* and the nest call of the parents need no further mention.

There is but one note given by cage birds that I have failed to hear in the wild and have not seen mentioned in the literature. This is a low pitched chuckle of weak intensity which cage birds give when approached and when completely at ease, that is to say, when they are not frightened or in any way excited. The note is given also as captive birds sit upon my hand while I stroke their throats or breasts. Doubtless this note is given in the wild by mated birds or among members of a family. It is never heard in the field because wild birds never are sufficiently at ease while being watched or else are not close enough to the observer for the note to be detected.

Captive nestlings develop perfectly all the notes of wild shrikes with the exception of the rhythmic types of song which never have been given by my cage birds.

CAUSES OF DEATH

Unfortunately little is known concerning the causes of death in American shrikes. These birds being moderately large, aggressive, and well equipped to fight, it is difficult to understand what happens to the relatively large number of young that are hatched annually. The reproductive rate is especially high for species that are predatory.

Instances of death other than by shooting which I have noted have occurred as a result of accident caused by automobiles on roadways. Robertson (1930) includes in his discussion of death of birds on roadways records of ten California Shrikes found dead during one year on the roads bounding a region roughly ten square miles in area in

southern California which was under daily observation by him. Without knowing intimately the area which he studied, I would estimate that one hundred and fifty shrikes might inhabit territories adjoining the roadways under consideration during the latter part of the fall season after the rapid postbreeding season mortality of immatures had ceased. This population of one hundred and fifty, of course, would decrease up to the time in the spring when young are hatched, when it would increase three- or fourfold. One hundred and fifty, however, might be considered an average population. From Robertson's figures it may be seen that at least 7 per cent of this average population is eliminated by accidental death on roads. Nevertheless, this number would be but 2 or 3 per cent of the maximum annual population at the end of the spring season. It is doubtful if this small per cent, even if it is considerably underestimated, outweighs the benefits derived from the use of perches and impaling posts provided through the presence of roads. Robertson concludes that the most likely cause of death is collision with automobiles, and that death is not caused to any extent by collision with overhead wires or by shooting. Wetmore (1929, pp. 141, 142) states that birds are struck down by automobiles most commonly in the early morning for the reason that the road surfaces at this time are well baited with insects injured during the night. In the early morning the roads are lightly traveled, but the few cars present are operated at high speed. I have observed that shrikes are prone to feed from road surfaces or from the edges of roads, either capturing injured insects or insects moving in the open and, consequently, easily obtained. A shrike while killing prey is likely to be practically oblivious to surrounding dangers and its powers to spring rapidly into the air are relatively poor.

The toll taken of shrikes by predatory birds or mammals is not known. A *gambeli* at Firebaugh, California, after retiring to its roost was heard to give repeated frantic screeches when a Horned Owl perched on a pole near by. A Barn Owl which approached and perched near the roost shortly after the Horned Owl had left provoked no such outburst from the shrike. E. L. Sumner, Jr., has found the remains of shrikes in Horned Owl nests (MS). Captive birds are greatly disturbed on being confronted with dead hawks or owls. Similar fear is displayed when hawks, cats, or dogs come near them. Therefore, there is some evidence to indicate that shrike populations experience losses through the feeding activities of large predatory birds and mammals.

It is believed that a large part of each annual increase in numbers is lost through the death of juvenal or immature individuals. The brood of six young at Pinole no. 6 were all known to leave the nest and all survived the first four days out of the nest. One died at the age of twenty-seven days as a result of insufficient feeding by the single remaining parent, perhaps complicated by a soaking rainstorm of the preceding night. This bird was the smallest of the brood and the last one hatched, and had also been retarded by an injury experienced when it first attempted to leave the nest, from which, however, it appeared to have recovered fully. At about thirty-five days of age, only three young could be found at no. 6, on a later date two, and finally only one. On the other hand, the pair at Pinole no. 7 raised at least five, and I believe, six, of a brood of seven young to a stage of complete independence. Broods of young when fully grown usually do not consist of more than four or five.

DISEASE AND PARASITES

I have twice shot immature birds with badly deformed bills which appeared to be the result of disease, perhaps following some injury. These individuals were in poor condition and certainly could not have survived for long.

Ectoparasites of the group Mallophaga may be seen on dead *gambeli*, not uncommonly as many as fifty being readily visible on the throat, where they congregate on the feather tips following death of the host. These Mallophaga appear to belong to the forms reported by Kellogg and Chapman (1899, p. 142) from *gambeli*, that is, *Docophorus communis* and *Nirmus foldus*. Both species occur on a number of passerine hosts. *D. communis* is known also from European members of the genus *Lanius* and from the American *L. excubitor*.

Cram (1927) in her survey of nematode bird parasites mentions the occurrence of several round worms in Old World shrikes. These are: *Viguiera euryoptera* and *Acuaria cordata* in *Lanius collurio* and in *Lanius senator; Harterteria zakhorowi, Viguiera euryoptera, Cheilospirura rotundata,* and *Physoloptera bilabiata* in *Lanius minor;* and, *Spirocerca sanguinolenta* (larva) in *Lanius excubitor dodsoni*. Of these parasites, *Viguiera euryoptera, Acuaria cordata,* and *Spirocerca sanguinolenta* are known from numerous other birds than the shrikes here mentioned.

Mr. Owen L. Williams has examined the digestive tracts of many of the specimens of *gambeli* collected by me in a search for nematode

worms. He reports the presence of *Acuaria* sp. in 17.64 per cent of a total of thirty-four birds examined. The *Acuaria* are found beneath the lining of the stomach and so far as known are not pathogenic. In one shrike a number of *Lemdana* sp. were found in the subcutaneous tissue at the base of the skull. The worms were found overlying the quadrate region and alongside the hyoid bones as well as between the muscles of the tongue. This kind of nematode infection is distinctly pathogenic.

Cram (1930) recently has reported the results of investigations concerning the relation of shrikes to the stomach worm of swine (*Physocephalus sexalatus*). She found that *L. l. ludovicianus* in southern Georgia and northern Florida was commonly infested with aberrant encysted stages of this parasite located in the walls of the digestive tract. Two species of dung beetles, *Phanaeus carnifex* and *Canthon laevis,* are the principal secondary hosts of the parasite and when eaten serve to infect insectivorous birds and pigs. It is believed that the large numbers of dung beetles eaten by shrikes and other birds are important in controlling the degree of infection in swine. Apparently the parasite is not pathogenic in the shrikes.

Coccidian infection has been reported in European shrikes but as yet has not been found in American members of the family.

The known parasites of shrikes rarely produce death and cannot be considered as contributing importantly to the death rate.

Age

Despite our ignorance concerning the causes of death in shrikes, the life expectation of individuals of the American species can be estimated by indirect means. Without knowing the juvenal mortality rate, it is difficult to use the size of the broods raised annually in determining the duration of life. More reliable data are obtained by comparing the proportions of first-year and second-year (or older) birds that compose the shrike populations.

The percentage of first-year birds in a population can be determined only from study skins. Objections to this method are that it is impossible to determine to what extent first-year birds are more readily collected than adults as a result of a lesser degree of wariness, and that the season during which collections are made influences the age composition of a series of skins. However, by eliminating birds taken previous to the first fall molt, an essentially mature population

of birds is selected which, on the average, in large series of skins should indicate the age composition of populations during the winter season. The result of a tabulation of age composition in the several races of both species of shrikes is shown in figure 65. The variation in the numbers of first-year birds ranges in the different races from 36 to 78 per cent of the total population.

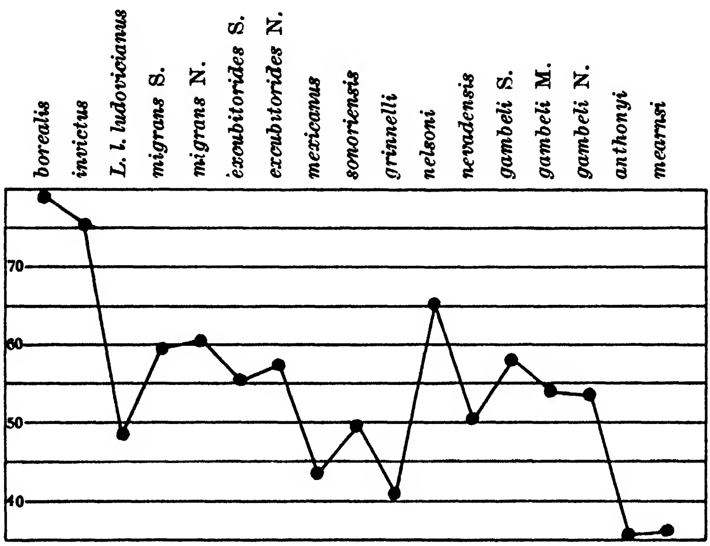

Fig. 65. Diagram showing geographic variation in per cent of first-year birds present in winter and spring populations of seventeen geographic groups. Statistics based on numbers of first-year birds and birds one year or more old present in series of study skins. For explanation of geographic groups see figure 40.

Usually in *L. ludovicianus* first-year birds make up about 50 per cent of winter populations. This means that annually half of the breeding population of the preceding season die and are replaced by first-year birds. Supposing that a family group in the spring consists of two adults and six juveniles, the succeeding year would, on the average, result in the death of one of these adults and five of the juveniles. Most of the juveniles would be lost before leaving their parents or during the first summer and autumn. Therefore, the juvenal and immature death rates are high, and the average life expectation of young upon leaving the nest is only about four months. The group of immatures which successfully pass the first winter, later as breeding birds, constitute 50 per cent of the total breeding population. Theoretically, during each succeeding year this same group must undergo a 50 per cent annual reduction by death. Consequently, of the birds which survive to breed once, roughly one-half live not more

than two years, one-quarter live three years, one-eighth four years, one-sixteenth five years, etc. This is true only if it is assumed that birds two years old are as efficient, wary, and alert as are older birds. Birds that have successsfully passed the first winter then, on the average live only two or three years. C. E. Brown (1928, p. 346) reports that an Indian shrike, *Lanius excubitor lahtora,* lived eight and one-half years in captivity. The bird's age at the time of capture was not known.

The differences in age composition of populations would seem to indicate differences in the number of replacements of adults required at each breeding season if the populations are to remain constant. It follows that American shrikes are not all subjected to the same death rate and, consequently, to the same severity of environmental conditions, environment here used in its broadest sense and including intra-racial competition. Populations of *excubitor* have an especially high percentage of first-year birds. *Nelsoni,* which inhabits what appears to be a region characterized by severe desert conditions, also is high in the percentage of first-year birds. The small size of the sets of *nelsoni* may not indicate necessarily a low reproductive rate if several broods regularly are raised in a season. Aside from *nelsoni,* the other resident races of *L. ludovicianus* are low in percentage of first-year birds in contrast to the migratory races. The island subspecies are especially lacking in first-year birds. Possibly these insular forms by their isolation are immune to the attacks of certain predatory mammals with which the mainland forms must cope.

Conclusions Concerning Behavior

American shrikes are occupied in the wild almost entirely by feeding, breeding, and the care of their plumage. All territorial and impaling habits are essentially a part of feeding or breeding activities. Adult shrikes when idle sit quietly or sleep; but young birds often appear to engage in play, hopping and flying about in an aimless fashion, carrying about bits of inanimate material, and engaging in mock combat with other young individuals. Some of this play activity must be looked upon as learning through trial and error methods and as providing necessary exercise in the use of the bill, feet, and wings. Just as a dog or cat upon maturing, for the most part, ceases to play, shrikes at the age of about six months cease playing and either are

inactive or are engaged in behavior which, in one way or another, seems immediately necessary to their existence or to the existence of their race.

All the important reactions of shrikes are basically hereditary, that is, they are instinctive. The initial instinctive reactions of juveniles usually may be classed as successful, although much in addition to instinct is learned by the individual. Memory involves visual, auditory, and probably tactile, olfactory, and gustatory sensations. Particularly acute is the memory of location and direction. Slightly less acute is the memory of shapes and sizes of objects and of kinds of sounds. Persons, for example, are readily recognized and differentiated as friend or stranger.

Any successful maneuver in obtaining exit from cages or in manipulating food is repeated on succeeding occasions without hesitation. A cage bird, which was deficient in wing power, once was placed on the floor below a perch upon which was located food impaled on a nail. The bird eyed the food and crouched preparing to jump upward in flight, but checked its contemplated action, evidently sensing its inability to complete the flight. It then hopped up to a perch intermediate in height and three times failed to fly to the food from this point. Following this, the shrike hopped about on the floor and finally prepared to move toward its goal by jumping from shelf to shelf of a bookcase which stood near by. First it looked at the food, then turned entirely around and eyed the bookcase, which it climbed. On reaching the level of the food it again turned about hurriedly and flew, successfully reaching its destination. During the next day, experiments with this bird showed that this indirect method of approach was then used at once in obtaining food similarly placed. A successful route once traversed, therefore, was repeated without further trial. But in addition to rapid learning, this shrike, while finding a means of reaching its food, appeared to gain in advance of its actions a visual impression of the indirect route which it was going to follow; it judged distances and heights with the ultimate goal in mind. Such action involves fairly complex associations and indicates a comparatively high degree of intelligence.

The individuality of shrikes further indicates that complex associations may be formed. While one cage bird responds to my presence by nibbling and mouthing my finger, another sits quietly and utters chuckling notes of "contentment." The two birds have come to associate my presence each with different kinds of reactions on their

part. Members of a brood vary as to the rapidity with which the more complex associations are formed. The adeptness of shrikes to discover a great variety of ways of procuring and handling food is a sign of a less rigid adherence to instinctive reaction patterns than the more strictly mechanical actions that are characteristic of captive and wild fringillids such as *Carpodacus mexicanus* or *Richmondena cardinalis*.

GENERAL SUMMARY

Studies in speciation are significant depending on the degree to which they are based on an understanding of structural variations, geographic distribution, and natural histories. The American shrikes were selected for study because of the relative incipiency of the differentiation within the group. This provides opportunities to study speciation in its earliest stages. The study also has been made because of the facilities available to the present worker for the study of natural history and because of the misunderstandings apparent in the literature concerning the existence and distribution of some of the geographic races and concerning certain phases of shrike behavior.

A number of external features have been analyzed with a view to the discovery of serviceable subspecific characters. These characters are listed and the age and sex variations of each are discussed.

Skins of 2083 American shrikes have been used in making the systematic revision of the group. This revision consists largely of the re-characterizations of races already described and of definitions of their ranges. It has also resulted in the publication of the descriptions of two heretofore unknown races of *Lanius ludovicianus* and a recommendation to the effect that *Lanius borealis* be considered specifically identical with *Lanius excubitor*, this latter decision being in accordance with the opinions already expressed by certain European ornithologists. The full separation of age and sex groups and a statistical treatment of the external dimensions of each of these groups have been important procedures for aiding in the characterization of the various geographic forms.

The first fall molt, particularly the degree of completeness of this molt, is shown to be widely different in the various races of *Lanius ludovicianus*. A statistical treatment of the varying composition of the first-year plumages of both species of American shrikes is presented.

Descriptions and figures of the pterylography of *Lanius ludovicianus* are included.

The age composition of various shrike populations is found to vary apparently in accordance with differences in the severity of environmental conditions and with variations in the migratory habit.

A brood of California Shrikes was taken from the nest at the age of two days and raised to maturity while in captivity. These captive birds and field studies made of shrikes in central and southern California have provided material for the account of natural history. Although this account is based primarily on *gambeli*, it includes available published information pertaining to the natural histories of other American shrikes. Shrikes are found to possess pronounced territorial habits which prevail throughout the year. Most of the reactions of shrikes are thought to be instinctive, yet the birds are able to learn rapidly and to form fairly complex mental associations.

The differentiation of subspecies in *Lanius ludovicianus* has resulted in the appearance of geographically variable features, some of which may be correlated with climate, some of which consist of adaptations to varying demands made upon the powers of flight, while still others are of unknown adaptive value and unknown correlation with environmental factors and may in certain instances be regarded as palingenetic.

Isolation, whether complete or partial, seems to have been an important factor in the evolution of the subspecies of American shrikes. Isolation without accompanying environmental differences, however, does not appear to have produced subspecies in *Lanius ludovicianus*. A sufficient contrast between two environments results in the differentiation of subspecies with the aid of only the partial isolation produced by intangible faunal and associational barriers.

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TYPE LOCALITIES OF BIRDS DESCRIBED FROM CALIFORNIA

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(Contribution from the Museum of Vertebrate Zoology of the University of California)

CONTENTS

INTRODUCTION

The rules of nomenclature require the permanent employment of the first name, of fairly certain application, given to each kind of animal. In the more recent refinements of taxonomy, when it has become desirable to designate by name forms distinguished but slightly from one another, the correct application of any name already proposed in a group requires careful heed to the minor features not only of the type specimen but often additionally to the characters in mass shown by series of specimens from the type locality. Not infrequently a type specimen has become lost or damaged, and then, even more, *topo*types are needed to settle the applications of names. In any case, the type locality needs to be known as exactly as possible, often far more precisely as to geographical position than may have been indicated in connection with the original published description or in any subsequent literature.

Ever since my interest became centered in the systematics of the birds of California I have kept note of facts and ideas pertaining to this often vital question of exact type locality; and latterly I have made special effort, in other museums and through correspondence,

toward that end. All the resulting information, even though in some cases still all too meager, is now gathered together and here set forth, for the use of other workers in the field of avian systematy.

The term "type locality" is used here to indicate the point from which a species or subspecies was originally described. This is normally determinable from the published record of the place where the type specimen, upon which the original diagnosis was chiefly or exclusively based, was obtained. But where no type specimen was designated, or where several localities were mentioned in connection with the original description, or where no locality for any specimen in the original describer's hands was given, or where neither specimen nor locality was given, various clues and methods have had to be sought, followed up and applied, leading to the establishment of a proper type locality. This procedure often involves close scrutiny of subsequent literature, the ransacking of old manuscript records, and the critical examination of the collections in the older museums.

The word "type" here means the actual specimen ("holotype"), usually a study skin or mounted bird, from which the original describer made his description, whether or not he definitely called any given bird the type. (Warning should, perhaps, be made against confusion with the quite different "type" of a genus, which is a species and not a specimen.) There can, in my opinion, be but one true type specimen. If the basis of the original description consisted of more than one specimen, then one of these, a "cotype," may often properly be determined as *the* type—on the criterion of special mention of it in the description, its use as subject of an illustration, or in absence of either of these bases of fixation, its subsequent selection as a type by the original author or by someone else. A cotype may thus become a "lectotype" and have full type significance; that is, it may properly, in my interpretation, be called *the type*. But in no case can a specimen be properly a type, that was not seen by the original describer of the species or subspecies in question at the time of, or prior to, his description. An arbitrarily selected, so-called "neotype" is not, to my notion, of any significance whatsoever, unless this be merely another way of alluding to a topotype. Very often, when no identifiable type exists, a type locality is, nevertheless, definitely of record, or, when not indicated in connection with the original description, it can be fixed with fair certainty and accuracy. Then any specimen of the same species *from that locality*, whether already collected or to be collected in the future, is ipso facto a *topotype*.

It is normally the type *locality* that is important in the fixation of a name to a subspecies or species of terrestrial vertebrate animal. The value of the type *specimen* in this regard has been vastly over-emphasized by many workers. Frequently the type specimen does not represent the mean of the population in the locality whence it came, and then topotypes, in series, become much the more important. True, in the case of migratory races of birds, where there is likelihood of more than one race occurring in a single neighborhood, the type specimen may become of importance in determining to which of two or more forms the name was originally applied. Even then, series from the type locality are desirable, even essential, for coming to a final determination. But, in any event, it is the type locality, determined as accurately as possible, that is of prime importance. Hence the main justification of the present contribution to the ornithology of California.

PLAN

The plan adhered to rather explicitly throughout the main list of species, those which have been named definitely from California (pages 259 to 314), is as follows:

The specific or subspecific name is given in exactly its original form, followed by the name of the author and then the citation of the original description. Date of publication is given as accurately as I have been able to determine it.

In square brackets beneath is given the name of the species or subspecies as now currently recognized. This name, however, is sometimes not the same as that employed in the Fourth Edition of the American Ornithologists' Union Check-list; it accords with my own separate view of the proprieties in each case of differment. In each such case, as a rule, but not always, I give briefly in a "note" the reasons for my position.

Under *type*, the sex of the type specimen (where known) is given, and the age of the bird (as recorded, or as indicated by the condition of the plumage); the condition of the specimen at the present time; by whom it was collected; its date of collection; the original or collector's number; its present number and its present location—that is, in what museum or private collection it is now preserved; and, finally, the date of my own examination of the specimen (which fact may prove of importance in the future) and such other comments as might seem to bear on the significance of the type for any phase of taxonomy.

Under *type locality* is given the place originally designated, and this has been expanded, wherever it has been found feasible, to make the information as exact as possible. Authority for such additional facts or inferences is usually given, and otherwise the course of reasoning or line of evidence from which I have arrived at the conclusion expressed. Even so, it will be observed, a number of cases have proved baffling; some have been left unsolved. And doubtless here and there I have fallen into error, as must happen in this sort of undertaking. Further critical study in this field is required.

The list of species is divided into two sections: the first, longer one (pages 259 to 314) consists of species definitely known to have been named from localities within the State of California as now politically bounded; the second or "hypothetical" list (pages 315 to 324) consists of names of doubtful application and of species originally ascribed to "California" but whose type localities have proven to be outside the present precincts of California, either through some mistake in ascription or as a result of the shrinkage of the area of "California" in the political history of the West.

A list of all the type localities in California is, of course, given (pages 248 to 256) with the names of the species and subspecies described from each locality; and the accompanying map (page 249) shows the locations of all these type localities. In separate lists are given: (1) the collectors (pages 257 and 258) of all the type specimens so far as known, with the number for each; (2) the museums (page 258) containing truly Californian types and the number of such types in each; and (3) the original describers (pages 258 and 259) of all the species and subspecies, with the number named by each.

Some summaries of interest in these connections are as follows: The 229 definitely California-taken type specimens were obtained by 74 different collectors. The earlier collectors, somewhat in the order of their activities, were as follows, with number of types collected by each: Archibald Menzies 2, Alexander Collie 13, P. A. Botta 4, Ferdinand Deppe 2, Thomas Nuttall 3, William Gambel 6, Edward M. Kern 1, John G. Bell 4, P. A. Delattre 2, A. L. Heermann 10, W. P. Trowbridge 2, and John Xantus 7.

Again, in 33 cases no type was designated, or the type has been lost track of, or it is known to have been destroyed. The remaining 196 types are contained in 16 museums or private collections. The greatest number, 82, is contained in the United States National Museum. Some other institutions, with numbers in each, are: Museum

of Vertebrate Zoology 52; Academy of Natural Sciences, Philadelphia, 12; collection of Donald R. Dickey 10; American Museum of Natural History 9; Museum of Comparative Zoology 7; Carnegie Museum 5; British Museum 4 (known, probably more).

Describers of the 229 new forms definitely of Californian origin number 56. The earlier of these authors were: Shaw and Nodder, describing 2 species; N. A. Vigors 13; R. P. Lesson 4; H. Lichtenstein 2; Thomas Nuttall 2; William Gambel 5; John Cassin 14; A. L. Heermann 2; C. L. Bonaparte 2; John Xantus 3; A. Malherbe 2; etc.

Finally, out of the 229 names applied to forms from California, 55 I consider synonyms, in most cases because the supposed races prove inseparable, but also, in other cases, because of purely priority considerations. In other words, 24 per cent of the names applied to California birds prove untenable. But even in these cases it is important to know accurately the type localities, because in the current lively shifting of concepts and criteria in systematics, some of these names are likely at any time to come into full estate.

ALPHABETICAL LIST OF TYPE LOCALITIES

It is found, in this study of mine, that a total of 258 bird names have been ascribed as new to California. Excluding altogether the 29 names of erroneous or doubtful pertinence, extralimital for the most part (see pages 315 to 324), there remain 229 names which have been based upon specimens from localities lying definitely within the present State of California. These localities, 98 in number, are listed below, with the bird names pertaining to each; and their positions are indicated on the accompanying map.

The most important single locality, it will be noted, is Monterey, whence no less than 23 birds have been newly named. This is obviously due to the situation of Monterey as one of the chief ports of call along the Californian coast in the early 1800's, as also to the circumstance that a most energetic ship's naturalist, Alexander Collie of the Blossom, found greatest opportunity at an early date to collect specimens there. Furthermore, his collections fell into the hands of a systematist, Vigors, who fully made known the novelties.

Other localities of "type" importance are: San Diego with 12 names; San Clemente Island and San Francisco with 10 each; Pasadena and Palo Alto with 9 each; Fort Tejòn with 8; and Nicasio with 7. These are explainable on the ground of their location as

places of early frequent visitation or upon their having been the homes of active collectors who either described their finds themselves or sent collections of specimens to eastern museums where specialists selected types from among them.

Baird, Shasta County:
Ardea herodias hyperonca Oberholser.
Callipepla californica vallicola Ridgway [=*Lophortyx californica californica* (Shaw and Nodder)].
Psaltriparus minimus californicus Ridgway.
Thryomanes bewickii drymoecus Oberholser.

Bard, Imperial County:
Rallus yumanensis Dickey [=*Rallus obsoletus yumanensis* Dickey].
Phalaenoptilus nuttallii hueyi Dickey.

Battle Creek, Shasta or Tehama County:
Certhia familiaris zelotes Osgood.
Pipilo fuscus carolae McGregor.
Melospiza fasciata ingersolli McGregor [=*Melospiza melodia merrilli* Brewster].

Bear Creek [=Bear River], Sutter or Yuba County:
Falco nigriceps Cassin [=*Falco peregrinus anatum* Bonaparte].

Bear Lake, San Bernardino County:
Chordeiles virginianus hesperis Grinnell [=*Chordeiles minor hesperis* Grinnell].

Big Trees, Calaveras County:
Turdus sequoiensis Belding [=*Hylocichla guttata sequoiensis* (Belding)].

Buena Vista Lake, Kern County:
Ixobrychus exilis hesperis Dickey and van Rossem.
Molothrus ater californicus Dickey and van Rossem.

Calaveras River, Calaveras County:
Glaucidium californicum Sclater [=*Glaucidium gnoma californicum* Sclater].
Ammodromus ruficeps Cassin [=*Aimophila ruficeps ruficeps* (Cassin)].

Chinquapin, Mariposa County:
Passerella iliaca mariposae Swarth.

Colton, San Bernardino County:
Guiraca caerulea salicarius Grinnell.

Corona, Riverside County:
Rallus virginianus pacificus Dickey [=*Rallus limicola pacificus* Dickey].

Coso Valley, Inyo County:
Otocoris alpestris ammophila Oberholser.

Crane Flat, Mariposa County:
Hesperiphona vespertina californica Grinnell [=*Hesperiphona vespertina brooksi* Grinnell].

Echo, Eldorado County:
Dendragapus obscurus sierrae Chapman [=*Dendragapus fuliginosus sierrae* Chapman].
Pinicola enucleator californica Price.

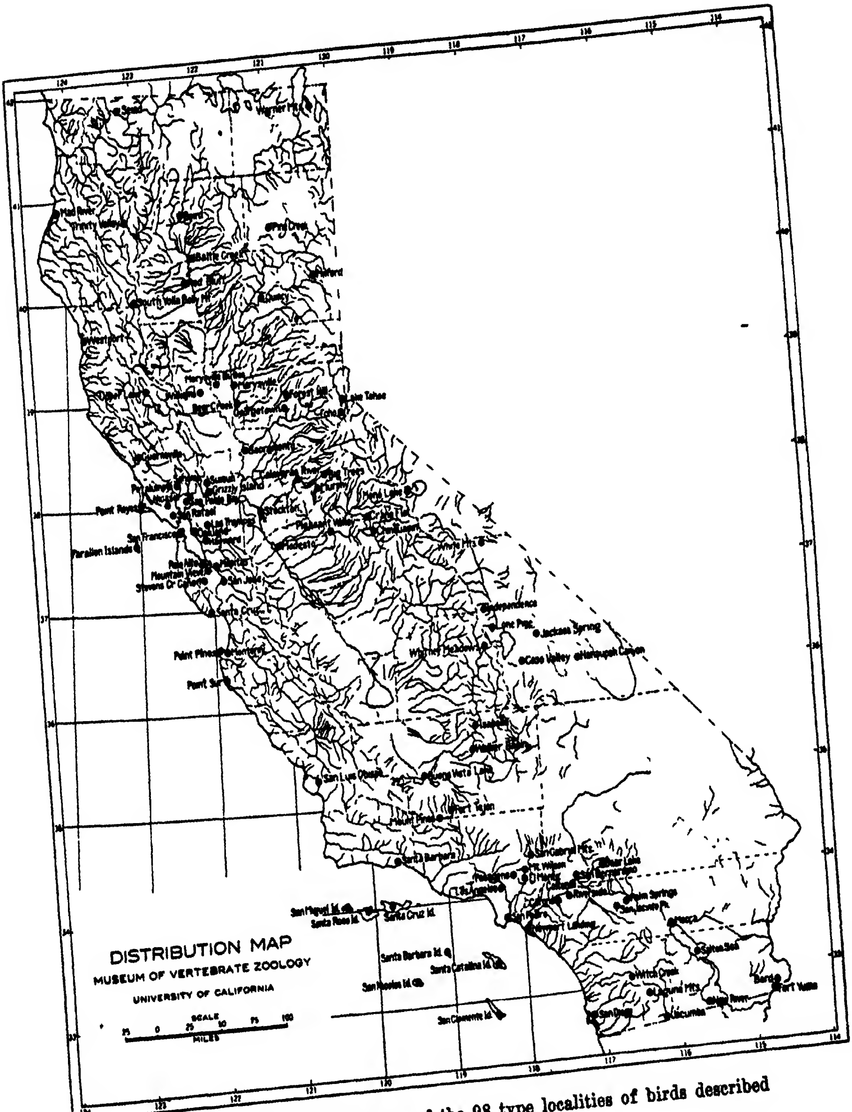

Fig. 1. Map showing locations of the 98 type localities of birds described definitely from California

EL MONTE, Los Angeles County:
Geothlypis trichas scirpicola Grinnell.

FARALLON ISLANDS, San Francisco County:
Cymochorea homochroa Coues [=*Oceanodroma homochroa* (Coues)].
Phalacrocorax dilophus albociliatus Ridgway [=*Phalacrocorax auritus albociliatus* Ridgway].
Graculus Bairdii Cooper [=*Phalacrocorax pelagicus resplendens* Audubon].
Porzana Jamaicensis, var. *coturniculus* Ridgway [=*Creciscus jamaicensis coturniculus* (Ridgway)].
Catarractes Californicus H. Bryant [=*Uria aalge californica* (H. Bryant)].

FOREST HILL, Placer County:
Catherpes mexicanus punctulatus Ridgway.

FORT TEJON, Kern County:
Syrnium occidentale Xantus [=*Strix occidentalis occidentalis* (Xantus)].
Tyrannula hammondii Xantus [=*Empidonax hammondii* (Xantus)].
Empidonax difficilis Baird [=*Empidonax difficilis difficilis* Baird].
Vireo cassinii Xantus [=*Vireo solitarius cassinii* Xantus].
Carpodacus californicus Baird [=*Carpodacus purpureus californicus* Baird].
Pipilo megalonyx Baird [=*Pipilo maculatus megalonyx* Baird].
Passerella megarhynchus Baird [=*Passerella iliaca megarhynchus* Baird].
Melospiza heermanni Baird [=*Melospiza melodia heermanni* Baird].

FORT YUMA, Imperial County:
Toxostoma Le Contei Lawrence [=*Toxostoma lecontei lecontei* Lawrence].

GEORGETOWN, Eldorado County:
Picus thyroideus Cassin [=*Sphyrapicus thyroideus thyroideus* (Cassin)].
Leuconerpes albolarvatus Cassin [=*Xenopicus albolarvatus albolarvatus* (Cassin)].

GRIZZLY ISLAND, Solano County:
Telmatodytes palustris aestuarinus Swarth.

GUERNEVILLE, Sonoma County:
Toxostoma redivivum sonomae Grinnell.

HANAUPAH CANYON, Inyo County:
Sitta carolinensis tenuissima Grinnell.

HAYWARD, Alameda County:
Hirundo bicolor var. *vespertina* Cooper [=*Iridoprocne bicolor* (Vieillot)].
Melospiza fasciata pusillula Ridgway [=*Melospiza melodia pusillula* Ridgway].

INDEPENDENCE, Inyo County:
Otus asio inyoensis Grinnell.

ISABELLA, Kern County:
Agelaius phoeniceus aciculatus Mailliard.

JACKASS SPRING, Inyo County:
Penthestes gambeli inyoensis Grinnell.

JACUMBA, San Diego County:
Otocoris alpestris actia Oberholser.
Agelaius phoeniceus neutralis Ridgway.

LAGUNA MOUNTAINS, San Diego County:
Tachycineta lepida Mearns [=*Tachycineta thalassina lepida* Mearns].

LAKE TAHOE, Eldorado County:
Tetrao Californica May [=*Dendragapus fuliginosus sierrae* Chapman].

LAS TRAMPAS PEAK, Contra Costa County:
Spizella atrogularis caurina A. H. Miller.

LONE PINE, Inyo County:
Lanius ludovicianus nevadensis A. H. Miller.

LOS ANGELES, Los Angeles County:
Picus Nuttalii [*sic*] Gambel [=*Dryobates nuttallii* (Gambel)].
Alauda rufa Audubon [=*Otocoris alpestris actia* Oberholser].
Mimus caudatus Baird [=*Mimus polyglottos leucopterus* (Vigors)].

MAD RIVER, Humboldt County:
Glaucidium gnoma grinnelli Ridgway.

MARYSVILLE, Yuba County:
Otocorys alpestris rubeus Henshaw [=*Otocoris alpestris rubea* Henshaw].

MARYSVILLE BUTTES, Sutter County:
Pipilo maculatus falcinellus Swarth.

MECCA, Riverside County:
Melospiza melodia saltonis Grinnell.

MILFORD, Lassen County:
Melospiza melodia fisherella Oberholser.

MILPITAS, Santa Clara County:
Ammodramus caudacutus becki Ridgway [=*Ammospiza caudacuta nelsoni* (Allen)].

MODESTO, Stanislaus County:
Melospiza melodia mailliardi Grinnell.

MONO LAKE, Mono County:
Passerella iliaca monoensis Grinnell and Storer.

MONTEREY, Monterey County:
Vultur Californianus Shaw and Nodder [=*Gymnogyps californianus* (Shaw and Nodder)].
Falco (*Buteo*) *ferrugineus* Lichtenstein [=*Buteo regalis* (Gray)].
Tetrao californicus Shaw and Nodder [=*Lophortyx californica californica* (Shaw and Nodder)].
Strepsilas melanocephalus Vigors [=*Arenaria melanocephala* (Vigors)].
Sterna Pikei Lawrence [=*Sterna paradisaea* Brünnich].
Columba monilis Vigors [=*Columba fasciata fasciata* Say].
Strix frontalis Lichtenstein [=*Cryptoglaux acadica acadica* (Gmelin)].
Colaptes collaris Vigors [=*Colaptes cafer collaris* Vigors].
Picus Turati Malherbe [=*Dryobates pubescens turati* (Malherbe)].
Picus Wilsonii Malherbe [=*Dryobates nuttallii* (Gambel)].
Muscicapa semiatra Vigors [=*Sayornis nigricans semiatra* (Vigors)].
Garrulus Californicus Vigors [=*Aphelocoma californica californica* (Vigors)].
Parus inornatus Gambel [=*Baeolophus inornatus inornatus* (Gambel)].
Sitta aculeata Cassin [=*Sitta carolinensis aculeata* Cassin].
Sitta pygmæa Vigors [=*Sitta pygmaea pygmaea* Vigors].

Parus fasciatus Gambel [=*Chamaea fasciata fasciata* (Gambel)].
Orpheus leucopterus Vigors [=*Mimus polyglottos leucopterus* (Vigors)].
Harpes rediviva Gambel [=*Toxostoma redivivum redivivum* (Gambel)].
Sialia cæruleocollis Vigors [=*Sialia mexicana occidentalis* J. K. Townsend].
Vireo huttoni Cassin [=*Vireo huttoni huttoni* Cassin].
Pyrrhula inornata Vigors [=, probably, *Carpodacus mexicanus frontalis* (Say)].
Fringilla crissalis Vigors [=*Pipilo fuscus crissalis* (Vigors)].
Fringilla meruloïdes Vigors [=*Passerella iliaca meruloïdes* (Vigors)].

MOUNT PINOS, in Kern and Ventura Counties:
Dendragapus obscurus howardi Dickey and van Rossem [=*Dendragapus fuliginosus howardi* Dickey and van Rossem].
Amphispiza belli canescens Grinnell.

MOUNT WILSON, Los Angeles County:
Parus gambeli baileyæ Grinnell [=*Penthestes gambeli baileyae* (Grinnell)].
Baeolophus inornatus transpositus Grinnell.
Regulus calendula cineraceus Grinnell [=*Corthylio calendula cineraceus* (Grinnell)].
Junco hyemalis thurberi Anthony [=*Junco oreganus thurberi* Anthony].

MOUNTAIN VIEW, Santa Clara County:
Buteo cooperi Cassin [=*Buteo borealis harlani* (Audubon)].

MURPHY, Calaveras County:
Lanius ludovicianus gambeli Ridgway.

NEW RIVER, Imperial County:
Dendrocygna bicolor helva Wetmore and Peters [=*Dendrocygna bicolor* (Vieillot)].

NEWPORT LANDING, Orange County:
Rallus levipes Bangs [=*Rallus obsoletus levipes* Bangs].

NICASIO, Marin County:
Scops asio bendirei Brewster [=*Otus asio bendirei* (Brewster)].
Phalaenoptilus nuttallii californicus Ridgway.
Selasphorus alleni Henshaw [=*Selasphorus sasin sasin* (Lesson)].
Aphelocoma californica oocleptica Swarth.
Parus rufescens, β. neglectus Ridgway [=*Penthestes rufescens neglectus* (Ridgway)].
Chamaea fasciata rufula Ridgway.
Thryomanes bewickii marinensis Grinnell.

OAKLAND, Alameda County:
Bæolophus inornatus restrictus Ridgway [=*Baeolophus inornatus inornatus* (Gambel)].
Passerculus sandwichensis bryanti Ridgway.

PALM SPRINGS, Riverside County:
Callipepla gambeli deserticola Stephens [=*Lophortyx gambelii gambelii* Gambel].
Auriparus flaviceps acaciarum Grinnell.

PALO ALTO, Santa Clara County:
Chamæa fasciata intermedia Grinnell [=*Chamaea fasciata fasciata* (Gambel)].
Dendroica aestiva brewsteri Grinnell.

Dendroica coronata hooveri McGregor.
Geothlypis trichas sinuosa Grinnell.
Agelaius phoeniceus mailliardorum van Rossem.
Euphagus cyanocephalus minusculus Grinnell.
Pipilo maculatus falcifer McGregor.
Pipilo fuscus petulans Grinnell and Swarth.
Melospiza melodia santaecrucis Grinnell.

PASADENA, Los Angeles County:
Otus asio quercinus Grinnell.
Glaucidium gnoma vigilante Grinnell [=*Glaucidium gnoma californicum* Sclater].
Sphyrapicus varius daggetti Grinnell.
Thryomanes bewickii correctus Grinnell.
Harporhynchus redivivus pasadenensis Grinnell [=*Toxostoma redivivum redivivum* (Gambel)].
Vireo pusillus albatus Grinnell [=*Vireo bellii pusillus* Coues].
Spinus tristis salicamans Grinnell.
Pipilo maculatus atratus Ridgway [=*Pipilo maculatus megalonyx* Baird].
Spizella passerina stridula Grinnell.

PETALUMA, Sonoma County:
Melanerpes formicivorus bairdi Ridgway [=*Balanosphyra formicivora bairdi* (Ridgway)].
Vireo swainsonii Baird [=*Vireo gilvus swainsonii* Baird].
Ammodramus Samuelis Baird [= *Melospiza melodia samuelis* (Baird)].

PINE CREEK, Lassen County:
Otocoris alpestris sierrae Oberholser [=*Otocoris alpestris merrilli* Dwight].

PLEASANT VALLEY, Mariposa County:
Polioptila caerulea amoenissima Grinnell.

POINT PINOS, Monterey County:
Junco pinosus Loomis [=*Junco oreganus pinosus* Loomis].

POINT REYES, Marin County:
Melospiza gouldii Baird [=*Melospiza melodia gouldii* Baird].

POINT SUR, Monterey County:
Hylocichla aonalaschkæ slevini Grinnell [=*Hylocichla guttata slevini* Grinnell].

QUINCY, Plumas County:
Dryobates villosus orius Oberholser.

RED BLUFF, Tehama County:
Wilsonia pusilla chryseola Ridgway.

RIVERSIDE, Riverside County:
Polioptila californica Brewster [=*Polioptila melanura californica* Brewster].
Phainopepla nitens lepida Van Tyne.
Vireo vicinior californicus Stephens [=*Vireo vicinior* Coues].

SACRAMENTO, Sacramento County:
Podilymbus lineatus Heermann [=*Podilymbus podiceps podiceps* (Linnaeus)].
Buteo elegans Cassin [=*Buteo lineatus elegans* Cassin].
Bubo virginianus. Variety *pacificus* Cassin [=*Bubo virginianus pacificus* Cassin].

Salton Sea, Imperial County:

Gelochelidon nilotica vanrossemi Bancroft [= *Gelochelidon nilotica aranea* (Wilson)].

San Bernardino, San Bernardino County:

Astragalinus psaltria hesperophilus Oberholser [= *Spinus psaltria hesperophilus* (Oberholser)].

San Clemente Island, Los Angeles County:

Ardea herodias oligista Oberholser [= *Ardea herodias hyperonca* Oberholser].
Selasphorus alleni sedentarius Grinnell [= *Selasphorus sasin sedentarius* Grinnell].
Otocoris alpestris insularis C. H. Townsend.
Thryothorus leucophrys Anthony [= *Thryomanes bewickii leucophrys* (Anthony)].
Lanius ludovicianus mearnsi Ridgway.
Helminthophila celata sordida C. H. Townsend [= *Vermivora celata sordida* (C. H. Townsend)].
Carpodacus clementis Mearns [= *Carpodacus mexicanus clementis* Mearns].
Pipilo clementæ Grinnell [= *Pipilo maculatus clementae* Grinnell].
Amphispiza belli clementeæ Ridgway [= *Amphispiza belli belli* (Cassin)].
Melospiza fasciata clementæ C. H. Townsend [= *Melospiza melodia clementae* C. H. Townsend].

San Diego, San Diego County:

Colymbus pacificus Lawrence [= *Gavia arctica pacifica* (Lawrence)].
Fulmarus glacialis columba Anthony [= *Fulmarus glacialis rodgersii* Cassin].
Herodias egretta, var. *californica* Baird [= *Casmerodius albus egretta* (Gmelin)].
Pelionetta trowbridgii Baird [= *Melanitta perspicillata* (Linnaeus)].
Larus Heermanni Cassin [= *Larus heermanni* Cassin].
Sterna antillarum browni Mearns.
Saurothera californiana Lesson [= *Geococcyx californianus* (Lesson)].
Saurothera Bottae Lesson [= *Geococcyx californianus* (Lesson)].
Passerculus beldingi Ridgway [= *Passerculus sandwichensis beldingi* Ridgway].
Emberiza rostrata Cassin [= *Passerculus sandwichensis rostratus* (Cassin)].
Aimophila ruficeps canescens Todd.
Melospiza fasciata cooperi Ridgway [= *Melospiza melodia cooperi* Ridgway].

San Francisco, San Francisco County:

Procellaria melania Bonaparte [= *Oceanodroma melania* (Bonaparte)].
Lophortyx californicus brunnescens Ridgway [= *Lophortyx californica brunnescens* Ridgway].
Rallus elegans, var. *obsoletus* Ridgway [= *Rallus obsoletus obsoletus* Ridgway].
Aegialitis nivosa Cassin [= *Charadrius nivosus nivosus* (Cassin)].
Ereunetes occidentalis Lawrence [= *Ereunetes mauri* Cabanis].
Recurvirostra occidentalis Vigors [= *Recurvirostra americana* Gmelin].
Ornismya Anna Lesson [= *Calypte anna* (Lesson)].
Ornismya Sasin Lesson [= *Selasphorus sasin sasin* (Lesson)].
Troglodytes spilurus Vigors [= *Thryomanes bewickii spilurus* (Vigors)].
Passerculus alaudinus Bonaparte [= *Passerculus sandwichensis alaudinus* Bonaparte].

San Gabriel Mountains, Los Angeles County:

Xenopicus gravirostris Grinnell [=*Xenopicus albolarvatus gravirostris* Grinnell].

Nuttallornis borealis majorinus Bangs and Penard [=*Nuttallornis mesoleucus majorinus* Bangs and Penard].

Zamelodia melanocephala microrhyncha Grinnell [=*Hedymeles melanocephalus melanocephalus* (Swainson)].

San Jacinto Mountains, Riverside County:

Passerella iliaca stephensi Anthony.

San Jose, Santa Clara County:

Buteo Californica Grayson [=*Buteo regalis* (Gray)].

Dryobates hyloscopus Cabanis and Heine [=*Dryobates villosus hyloscopus* Cabanis and Heine].

San Luis Obispo, San Luis Obispo County:

Asio magellanicus icelus Oberholser [=*Bubo virginianus pacificus* Cassin].

San Miguel Island, Santa Barbara County:

Melospiza melodia micronyx Grinnell.

San Nicolas Island, Ventura County:

Puffinus creatopus Coues.

Salpinctes obsoletus pulverius Grinnell [=*Salpinctes obsoletus obsoletus* (Say)].

San Pablo Bay, Solano County:

Podiceps clarkii Lawrence [=*Aechmophorus occidentalis* (Lawrence)].

San Pedro, Los Angeles County:

Podiceps Californicus Heermann [=*Colymbus nigricollis californicus* Heermann)].

San Rafael, Marin County:

Elanus leucurus majusculus Bangs and Penard.

Santa Barbara, Santa Barbara County:

Trochilus violajugulum Jeffries [=hybrid between *Archilochus alexandri* (Bourcier and Mulsant) and *Calypte anna* (Lesson)].

Trochilus icterocephalus Nuttall [=*Calypte anna* (Lesson)].

Corvus nutallii [*sic*] Audubon [=*Pica nuttallii* (Audubon)].

Hylocichla ustulata œdica Oberholser [=*Hylocichla ustulata ustulata* (Nuttall)].

Agelaius calocephalus Nuttall [=, probably, *Xanthocephalus xanthocephalus* (Bonaparte)].

Icterus tricolor Audubon [=*Agelaius tricolor* (Audubon)].

Santa Barbara Island, Los Angeles County:

Melospiza fasciata graminea C. H. Townsend [=*Melospiza melodia graminea* C. H. Townsend].

Santa Catalina Island, Los Angeles County:

Lophortyx catalinensis Grinnell [=*Lophortyx californica catalinensis* Grinnell].

Larus occidentalis wymani Dickey and van Rossem.

Mergulus Cassinii Gambel [=*Ptychoramphus aleuticus* (Pallas)].

Thryomanes bewickii catalinae Grinnell.

Santa Cruz, Santa Cruz County:

Zonotrichia leucophrys nuttalli Ridgway.

SANTA CRUZ ISLAND, Santa Barbara County:
Aphelocoma insularis Henshaw.
Thryomanes bewickii nesophilus Oberholser.
Lanius ludovicianus anthonyi Mearns.
Vireo mailliardorum Grinnell [= *Vireo huttoni huttoni* Cassin].
Aimophila obscura Dickey and van Rossem [= *Aimophila ruficeps obscura* Dickey and van Rossem].

SANTA ROSA ISLAND, Santa Barbara County:
Empidonax insulicola Oberholser [= *Empidonax difficilis difficilis* Baird].

SEIAD, Siskiyou County:
Penthestes gambeli abbreviatus Grinnell.

SONOMA, Sonoma County:
Carduelis Lawrencei Cassin [= *Spinus lawrencei* (Cassin)].
Emberiza Belli Cassin [= *Amphispiza belli belli* (Cassin)].

SOUTH YOLLA BOLLY MOUNTAIN, Trinity County:
Passerella iliaca brevicauda Mailliard.

STEVENS CREEK CAÑON, Santa Clara County:
Cyanocitta stelleri carbonacea Grinnell.
Parus rufescens barlowi Grinnell [= *Penthestes rufescens barlowi* (Grinnell)].

STOCKTON, San Joaquin County:
Larus Californicus Lawrence [= *Larus californicus* Lawrence].
Icteria longicauda Lawrence [= *Icteria virens longicauda* Lawrence].
Agelaius gubernator californicus Nelson [= *Agelaius phoeniceus californicus* Nelson].

SUISUN, Solano County:
Melospiza melodia maxillaris Grinnell.

TRINITY VALLEY, Trinity County:
Melanerpes rubrigularis Sclater [= *Sphyrapicus thyroideus thyroideus* (Cassin)].

UPPER LAKE, Lake County:
Speotyto cunicularia obscura Stephens [= *Speotyto cunicularia hypugaea* (Bonaparte)].

WALKER BASIN, Kern County:
Chamaea fasciata henshawi Ridgway.

WARNER MOUNTAINS, Modoc County:
Passerella iliaca fulva Swarth.

WHITE MOUNTAINS, Inyo County:
Hylocichla guttata polionota Grinnell.
Passerella iliaca canescens Swarth.

WHITNEY MEADOWS, Tulare County:
Leucosticte tephrocotis dawsoni Grinnell.

WILLIAMS, Colusa County:
Otocoris berlepschi Hartert [= *Otocoris alpestris rubea* Henshaw].

WITCH CREEK, San Diego County:
Vireo huttoni oberholseri Bishop [= *Vireo huttoni huttoni* Cassin].

WESTPORT, Mendocino County:
Melospiza melodia cleonensis McGregor.

COLLECTORS OF CALIFORNIAN BIRD TYPES

Annie M. Alexander 1
Charles A. Allen 6
Malcolm P. Anderson 1
Alfred W. Anthony 4
Rollo H. Beck 2
Lyman Belding 5
John G. Bell 4
Paolo E. Botta 4
Thomas Bridges 1
Walter E. Bryant 1
A. Sterling Bunnell 2
May Canfield 1
May Canfield and Laurence M. Huey 1
Andrew Cassidy 2
Norman Clyde 1
Alexander Collie 13
James G. Cooper 3
William A. Cooper 1
Frank S. Daggett 1
Pierre A. Delattre 2
Ferdinand Deppe 2
Donald R. Dickey and Adriaan J. van Rossem 1
Joseph Dixon 2
W. Otto Emerson 1
Albert K. Fisher 1
William Gambel 6
Edward Garner 1
Andrew J. Grayson 1
Joseph Grinnell 35
Joseph Grinnell and Joseph Dixon 1
Joseph Grinnell and Hilda W. Grinnell 1
Ferdinand Gruber 6
Adolphus L. Heermann 10
Henry W. Henshaw 3
E. S. Holden 2
Theodore J. Hoover 3
John Hornung 1
William Hutton 1
J. Amory Jeffries 1
Louise Kellogg 1
Edward M. Kern 1
Chester C. Lamb 1
John L. Leconte 1
Leverett M. Loomis 1
Joseph Mailliard 1
Henry W. Marsden 1
Richard C. McGregor 4
Edgar A. Mearns 8
Archibald Menzies 2
Alden H. Miller 1
Edward W. Nelson 1
John S. Newberry 1
Thomas Nuttall 3
Theodore S. Palmer 1
William W. Price and Charles S. Dole 1
Charles H. Richardson, Jr. 3
Emanuel Samuels 3
Alfred C. Shelton 1
Alfred C. Shelton and George E. Stone 1
Perry O. Simons 1
Thomas E. Slevin 1
Frank Stephens 6
Tracy I. Storer 1
Clark P. Streator 1
George Suckley 1
Harry S. Swarth 1
Walter P. Taylor 2
Walter P. Taylor and Harold C. Bryant 1
Eugene C. Thurber 1

Charles H. Townsend 12
William P. Trowbridge 2
Unknown 12
Adriaan J. van Rossem 7
Halsted G. White 1
John Xantus 7

MUSEUMS CONTAINING CALIFORNIAN BIRD TYPES

American Museum of Natural History, New York 9
Academy of Natural Sciences of Philadelphia 12
Berlin: Zoologisches Museum der Universität 3
Louis B. Bishop collection 1
British Museum of Natural History 4 (probably more)
California Academy of Sciences 2 (formerly) plus 2 (in 1930)
Carnegie Museum, Pittsburgh 5
Donald R. Dickey collection 10
Milan: Civic Museum 1
Museum of Comparative Zoology, Cambridge 7
Museum of Vertebrate Zoology, University of California 52
Paris: Muséum National d'Histoire Naturelle 2
San Diego Society of Natural History 1
Senckenbergisches Institut and Museum, Frankfurt 1
Stanford University, Museum of Zoology 2
United States National Museum 82 (in 1930)
Unknown 33

LIST OF ORIGINAL DESCRIBERS

Alfred W. Anthony 4
John J. Audubon 3
Spencer F. Baird 11
Griffing Bancroft 1
Outram Bangs 1
Outram Bangs and Thomas E. Penard 2
Lyman Belding 1
Louis B. Bishop 1
Charles Lucien Bonaparte 2
William Brewster 2
Henry Bryant 1
Jean Cabanis and Ferdinand Heine 1
John Cassin 14
Frank M. Chapman 1
James G. Cooper 2
Elliott Coues 2
Donald R. Dickey 3
Donald R. Dickey and Adriaan J. van Rossem 5
William Gambel 5
Andrew J. Grayson 1
Joseph Grinnell 46
Joseph Grinnell and Tracy I. Storer 1
Joseph Grinnell and Harry S. Swarth 1
Adolphus L. Heermann 2
Henry W. Henshaw 3
Ernst Hartert 1
J. Amory Jeffries 1
George N. Lawrence 7
René P. Lesson 4

Heinrich Lichtenstein 2
Leverett M. Loomis 1
Joseph Mailliard 2
Alfred Malherbe 2
William B. May 1
Richard C. McGregor 5
Edgar A. Mearns 4
Alden H. Miller 2
Edward W. Nelson 1
Thomas Nuttall 2
Harry C. Oberholser 13
Wilfred H. Osgood 1
William W. Price 1
Robert Ridgway 26
Philip L. Sclater 2
George Shaw and Francis P. Nodder 2
Frank Stephens 3
Harry S. Swarth 6
W. E. Clyde Todd 1
Charles H. Townsend 4
Adriaan J. van Rossem 1
Josselyn Van Tyne 1
Nicholas A. Vigors 13
Alexander Wetmore and James L. Peters 1
John Xantus 3

SPECIES NAMED DEFINITELY FROM CALIFORNIA

Colymbus pacificus Lawrence, *in* Baird, Pac. R. R. Repts., **9**, 1858, pp. 887, 889–890.

[= *Gavia arctica pacifica* (Lawrence).]

Type, [once considered to be] skin, [sex?] immature; collected by Lieut. W. P. Trowbridge [probably in 1853]; no. 9921, U. S. Nat. Mus.; "San Diego, Cal." But this bird is not now in the National Museum, and its fate can only be surmised, as shown below.

Two specimens are listed by Lawrence (*loc. cit.*): no. 9921, in later years considered the type, and no. 9924, from "Puget's Sound"; about 1859 the former was sent to the University of Michigan along with other birds, and the latter, in 1870, went to the Chicago Academy of Sciences. Doubtless this last specimen was burned in the Chicago fire.

In regard to the University of Michigan specimen, I enquired of Dr. J. Van Tyne, Assistant Curator of Birds in the Museum of Zoology there. He reports (in letter of January 6, 1930) as follows: "We have a specimen with the National Museum No. 9921 . . . [which] was entered in the Trowbridge Catalogue as *Colymbus pacificus*, and as far as we can now judge the label is probably on the same skin on which it was first placed [but this is a printed label, not the original U. S. Nat. Mus. label]. On the other hand our skin [bearing this number and label] is an adult *Gavia stellata* (in the red-throated plumage) and the locality data is not the same as [for either of] Lawrence's birds." The locality is given on the printed label as "Presidio (near San Francisco), Cal." Lawrence's description, it is to be noted here, applies definitely to immature *pacifica* and not to *stellata.*

Enquiry at the United States National Museum, under the guidance of Dr. C. W. Richmond, shows the next specimen on the old Smithsonian register to be recorded as: 9922 "Colymbus Septentrionalis . . . San Diego . . . R. S. Williamson [entered] March 24,

1858 . . . Sent to Oberlin College March 21/88." This bird, mounted, is, I was informed by Dr. Lynds Jones, still in the Zoological Museum of Oberlin College. It is no. 294 there, and the catalogue entry reads further, "U. S. N. M. 9922. Urinator pacificus. San Diego . . . ". But—it is positively "*septentrionalis*," that is, *stellata* (forwarded by Dr. Jones and so identified by me December 29, 1930).

There is thus evidence that the number and (or) data of several loons of two or three species listed together were transposed in copying data onto new labels, or (and) in attaching them to, or associating them with, specimens; errors so committed seem beyond present hope of rectification. In other words, no type specimen of *pacifica*, positively recognizable as such, is now known to be extant.

Type locality, "San Diego" or "Puget's Sound," according to indication in original description; properly to be restricted to San Diego, San Diego County, as best according with all the facts given above.

Podiceps Californicus Heermann, Proc. Acad. Nat. Sci. Phila., 7, "October", 1854 [= April 12, 1855], p. 179.

[= *Colymbus nigricollis californicus* (Heermann).]

Type: [sex ?, probably female], mounted bird in fair condition; terminal third of maxilla missing; plumage somewhat browned by exposure to light; young-of-the-year in normal first-winter plumage; no. 9942, United States National Museum [forwarded and examined by me January 7, 1931]. Dr. C. W. Richmond writes me (under date December 11, 1930) that the Smithsonian records show that this bird was collected by Dr. A. L. Heermann [probably in the fall of 1853] at San Pedro, California, and that it was received from Lt. R. S. Williamson. These data accord with those given for no. 9942 in Lawrence's table (*in* Baird, Pac. R. R. Repts., **9**, 1858, p. 897). Baird (Birds N. Am., 1860, p. vii [explanation of plates]) says plate 8 (of the work just cited) was drawn "From Dr. Heermann's type specimen." A footnote on the same page indicates that, when not otherwise noted, the specimen drawn is to be understood as contained in the Smithsonian Institution. No. 9942 is the only Heermann-taken specimen of this species ever recorded there, insofar as now known.

The above considerations tend to negative the claims of typeship for a specimen (no. 30072), of less definite history, in the Academy of Natural Sciences, Philadelphia (see Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 22). This specimen (examined by me October 18, 1929) is a skin taken down from a mount, young-of-the-year (probably female) in normal first-winter plumage. The data, "Calif. A. L. Heermann," was copied by Dr. Stone from the old stand, which was also marked "type." Heermann might very well have collected winter-plumaged eared grebes also during his 1849–52 sojourn in California.

Of historical interest is the fact that, in January, 1880, no. 9942 was sent by gift from the Smithsonian to Wesleyan University, Middletown, Connecticut. There it remained fifty years, until November, 1930, when, upon request, it was returned to the United States National Museum, where it now is.

Type locality: Only "California" given in connection with original description. For reasons now apparent, restricted to SAN PEDRO, Los Angeles County.

Podiceps clarkii Lawrence, *in* Baird, Pac. R. R. Repts., 9, 1858, pp. 892, 895.

[= *Aechmophorus occidentalis* (Lawrence).]

Type, [probably female]; skin in rather poor condition; in seemingly early autumn plumage, first year; collected by Dr. J[ohn]. S[trong]. Newberry, [in November, 1855]; no. 4498, U. S. Nat Mus. [Examined by me October 30, 1929.]

Type locality: Habitat given as "California and New Mexico." Three specimens listed, one of which, from "San Pablo bay, Cal.", no. 4498, as above, was subsequently selected at the National Museum for typeship. That this was probably the correct course is indicated by the fact that the measurements given in the description above on the same page (Lawrence, *loc. cit.*) are those given in the table for this specimen. Also in the subsequent discussions of the supposed species *clarkii*, by Coues, Ridgway, Henshaw and others, it is spoken of as from the "Pacific coast." The type locality may thus be accepted as SAN PABLO BAY, probably within Solano County, and not far from Vallejo.

Podilymbus lineatus Heermann, Proc. Acad. Nat. Sci. Phila., 7, "October", 1854 [= April 12, 1855], pp. 179–180.

[= *Polilymbus podiceps podiceps* (Linnaeus).]

Type, [sex ?, probably female]; skin taken down from mount, in full juvenal plumage; taken in "summer," probably rather late, by Dr. A. L. Heermann himself, as he so states; no. 4738, Acad. Nat. Sci. Phila. [Examined by me October 18, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 22.)

Type locality, " . . . fresh water courses and marshy lakes of California." Since most of Heermann's collecting in 1849–52 was done in the neighborhood of "Sacramento city" (Journ. Acad. Nat. Sci. Phila., ser. 2, 2, 1853, pp. 259, 272), and since all his remarks concerning this grebe apply well to conditions in that vicinity, and also since no example of this kind of grebe was taken during the 1853 railroad explorations under Lt. Williamson (see Heermann, Pac. R. R. Repts., 10, Zool., no. 2, 1859, pp. 77, 80), the type locality for *P. lineatus* can now properly be fixed as SACRAMENTO, Sacramento County.

Puffinus creatopus ["Cooper (MSS.)"] Coues, Proc. Acad. Nat. Sci. Phila., "April" [by June 30], 1864, p. 131.

[= *Puffinus creatopus* Coues.]

Type, [sex ?]; skin in fair condition; plumage shows mixture of old worn and new fresh feathers; collected by Dr. James G. Cooper, July 1, 1863; the oldest label is on card-board and inscribed in lead-pencil in Cooper's handwriting; another label indicates that the specimen came from the Geological Survey of California, to which organization it for a time belonged; now no. 31964, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality, SAN NICOLAS ISLAND, Ventura County; that is, waters close about that island (see Baird, Brewer and Ridgway, Water Birds N. Am., **2**, 1884, p. 384).

Fulmarus glacialis columba Anthony, Auk, **12**, April, 1895, pp. 105–106.

[= *Fulmarus glacialis rodgersii* Cassin.]

Types, two: "light phase," female in full, unworn plumage; skin in excellent condition; collected by Alfred W. Anthony, February 17 [not "21"], 1894; orig. no. 4914, coll. A. W. A.; now no. 21903, Carnegie Museum; "dark phase," female in full, unworn plumage; skin in excellent condition; collected by Alfred W. Anthony, October 16, 1894; orig. no. 5596, coll. A. W. A.; now no. 21905, Carnegie Museum. [Both skins forwarded and examined by me, May 7, 1930.] It does not seem possible arbitrarily to say that the first is *the* type, for only the second shows the chief color character advanced in the diagnosis of the supposed race. Each is a cotype.

Type locality, [Pacific Ocean some ten miles] off SAN DIEGO, San Diego County; "10 miles off shore" appears on the label of no. 21905.

Procellaria melania Bonaparte, Comptes Rendus, **38**, April [3], 1854, p. 662.

[= *Oceanodroma melania* (Bonaparte).]

Type, no. 14369A (new catalogue no. 11) in the Paris Museum of Natural History; the record accompanying it gives "Californie, Delattre, 1853" (*fide* Mr. J. Berlioz, *in litt.*, May 5, 1930; also see Berlioz, Bull. Mus. d'Hist. Nat. Paris, ser. 2, **1**, 1929, p. 61). Pierre Adolphe Delattre collected birds when very young in west-central California, probably chiefly in the neighborhood of San Francisco, during the period from the latter part of 1851 to the beginning of 1853 (see Palmer, Condor, **20**, 1918, p. 123).

Type locality, originally published only as "la Californie." In view of the above statements, the suggested designation of San Diego as the type locality (A. O. U. Check-list, ed. 3, 1910, p. 57) is not here followed. Delattre reached San Francisco by sailing vessel and the possibility suggests itself that the petrel in question flew aboard somewhere along the course of the boat more or less distance south of San Francisco. But there is also no apparent reason why it could not have come to Delattre's hand from the ocean, or from the ocean shore during a storm, in the immediate vicinity of San Francisco at some time during his extended stay there. For the species is now well known to occur at certain seasons in numbers north even as far as off Point Reyes. Vicinity of SAN FRANCISCO, San Francisco County, is therefore here accepted as the most probable type locality.

Cymochorea homochroa Coues, Proc. Acad. Nat. Sci. Phila., "March" [by June 30], 1864, pp. 77–78.

[= *Oceanodroma homochroa* (Coues).]

Type, [sex ?]; good skin in full [probably breeding] plumage; collected by, or for, F[erdinand]. Gruber; no date, but "entered" at the Smithsonian Institution, February 28, 1861; no. 21444, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality, "Farallone Islands, Pacific coast of North America"; that is, FARALLON ISLANDS, San Francisco County.

Phalacrocorax dilophus albociliatus Ridgway, Proc. Biol. Soc. Wash., **2**, April 10, 1884, p. 94.

[= *Phalacrocorax auritus albociliatus* Ridgway.]

Type, none designated in original description, and none selected subsequently insofar as I have been able to find out. Dr. C. W. Richmond, to whom I appealed in this case as in so many others, points out that the original description would seem to require a type showing white nuptial tufts, but that among the several Farallon-taken birds now contained in the National Museum collection none has that feature well developed. Dr. Richmond says (in letter of December 30, 1929): "Mr. Ridgway had 12 specimens available in 1884, but I do not know that they were all in our collection. He gave various localities in the west, down to Lower California, and it is possible his white-tufted birds came from some other place than the Farallones."

Type locality, FARALLON ISLANDS, San Francisco County; so fixed, apparently, in A. O. U. Check-list, ed. 3, 1910, p. 63; also the race had been called in the vernacular "Farallon Cormorant" so early as the first edition of the Check-list, 1886.

Graculus Bairdii ["Gruber, MSS."] Cooper. Proc. Acad. Nat. Sci. Phila., January, 1865, p. 5.

[=*Phalacrocorax pelagicus resplendens* Audubon.]

Type, none designated. Cooper (*loc. cit.,* p. 6) says: "Mr. F[erdinand]. Gruber, of this city [San Francisco], was the first to secure specimens of the species and distribute them as *P[halacrocorax]. bairdii,* (named after Prof. S. F. Baird, of the Smithsonian Institution) and informs me that the species was published under that name in Germany, although I have not been able to find it, and think it is possible that it may still be a manuscript communication." Later, Cooper (Proc. Calif. Acad. Sci., **4**, 1868, p. 12) reaffirms: "Was obtained by Mr. Gruber at the Farallones and afterwards by myself."

Appeal to Dr. Erwin Stresemann of the Berlin Museum and to Dr. Charles W. Richmond of the United States National Museum discloses no present-day knowledge as to any description, with possible designation of type, having ever been printed in Germany. So Cooper's surmise that Gruber's name was purely a manuscript one proves likely correct, and the name must continue to date from Cooper, 1865.

Gruber-collected specimens with labels bearing the name *bairdii* were extant as early as 1861. For Dr. Richmond informs me (*in litt.,* December 30, 1929) that of two birds in the National Museum (nos. 23242, 28147) taken by Gruber on the Farallones, and so labeled, the first, "♂, April, 1861, orig. no. 2," was catalogued December 31, 1861, and the second, "♂, June 19, 1862, orig. no. 77," was catalogued in April, 1863. That either of these can be considered the actual type, however, is negatived by the fact that in neither case do their measurements agree with those given by Cooper in his original description; and it is doubtful if Cooper himself ever saw these particular speci-

mens. Also in the Berlin Museum there are two Gruber-taken specimens (nos. 17503–04) from the Farallones, taken there in April and June, 1861; but they are listed by Cabanis as *Halieus violaceus*—no mention of the name *bairdii* (*fide* Dr. E. Stresemann, *in litt.*, February 14, 1930).

In the Museum of Vertebrate Zoology is a skin (no. 4411), once in the J. G. Cooper collection and thereafter in that of the California Geological Survey, whose original label shows it to have been collected on the Farallon Islands, by F. Gruber, June 16, 1862. "White-patched Cormorant. (Graculus bairdii) male." is the first line on the long letter-paper label inscribed in Cooper's handwriting. In this case, too, the measurements, and also the colors of soft parts, do not accord exactly with Cooper's descriptive statements. Of course there is the chance that Cooper generalized from several specimens, but that can be only guess on my part. This latter specimen can properly be called at least a cotype; for it passed through Cooper's hands. But as to a veritable type, it does not seem possible at this writing to pick out this or any other one specimen to designate as such.

Type locality, FARALLON ISLANDS, San Francisco County; definitely so indicated in the heading of Cooper's description.

Ardea herodias hyperonca Oberholser, Proc. U. S. Nat Mus., **43**, December 12, 1912, pp. 550–551.

[= *Ardea herodias hyperonca* Oberholser.]

Type, [male] adult; skin in good condition; collected by Charles H. Townsend, March 3, 1884; orig. no. 580; now no. 98486, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, BAIRD [the, then, United States Fishery, near mouth of McCloud River], Shasta County.

Ardea herodias oligista Oberholser, Proc. U. S. Nat. Mus., **43**, December 12, 1912, p. 553.

[= *Ardea herodias hyperonca* Oberholser.]

Type, male [not "adult," I think, but young-of-the-year—shows molt in progress, apparently out of juvenal plumage]; skin in good condition though somewhat greasy; collected by Edgar A. Mearns, August 26, 1894; orig. no. 11362; now no. 135573, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County [doubtless vicinity of Smugglers (now Pyramid) Cove—see Mearns, U. S. Nat. Mus. Bull., **56**, 1907, p. 139].

Herodias egretta, var. **californica** Baird, Pac. R. R. Repts., **9**, 1858, p. 667.

[= *Casmerodius albus egretta* (Gmelin).]

Type, [sex ?], non-breeding; skin in fair condition, though greasy and yellowed; collected by "A. Cassidy" [no date, but likely in 1855] and received at the Smithsonian Institution from Lieut. W. P. Trowbridge ["entered" there, March 13, 1858]; no. 9470 [not "9070"], U. S. Nat Mus. [Examined by me, October 30, 1929.]

Type locality, SAN DIEGO, San Diego County.

Ixobrychus exilis hesperis Dickey and van Rossem, Bull. Southern Calif. Acad. Sci., **23**, January-February [= February 20], 1924, p. 11.

[= *Ixobrychus exilis hesperis* Dickey and van Rossem.]

Type, male adult, "breeding," skin in good condition; collected by A. J. van Rossem, July 2, 1922; orig. no. 7028; now no. K 349, coll. Donald R. Dickey. [Examined by me April 15, 1930.]

Type locality, BUENA VISTA LAKE, Kern County.

Dendrocygna bicolor helva Wetmore and Peters, Proc. Biol. Soc. Wash., **35**, March 20, 1922, p. 42.

[= *Dendrocygna bicolor* (Vieillot).]

Type, male adult; skin in excellent condition; collected by Edgar A. Mearns, April 30, 1894; orig. no. 10730; now no. 135588, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, "Unlucky Lake, San Diego County." This was a shallow overflow (not now in existence) from NEW RIVER, in Imperial County about two miles north of the Mexican boundary at Monument No. 221 (see Mearns, U. S. Nat. Mus. Bull., **56**, 1907, p. 131).

Pelionetta trowbridgii Baird, Pac. R. R. Repts., **9**, 1858, pp. 806–807.

[= *Melanitta perspicillata* (Linnaeus).]

Type, [male adult], skin, taken down from mount, in good condition; the Smithsonian records show that this bird was collected by "A[ndrew]. Cassidy" [about 1853 or 1855] and was received from Lieut. W. P. Trowbridge; now no. 12728, U. S. Nat Mus., though this specimen was originally either no. 9860 or 9861 (see Baird, *loc. cit.*). [Examined by me October 30, 1929.]

Type locality, SAN DIEGO, San Diego County.

Vultur Californianus Shaw and Nodder, Naturalist's Miscellany, **9**, 1797, pl. 301 and accompanying text (5 pp.).

[= *Gymnogyps californianus* (Shaw and Nodder).]

Type, in British Museum: An adult bird, a "skin" (once mounted) in rather poor condition; no stuffing (or very little) in the body; wings were imperfectly cleaned or poisoned, so that most of the lesser coverts "slipped" and are gone; legs partly decayed before drying; a piece broken from left side and tip of upper mandible and fragment tied in bit of paper attached to leg; naked skin of head and neck has been painted a dull pinkish drab, through which the black markings show obscurely. The only label now on this specimen is not an old or original one; one side is blank, the other reads: "No. 10. 5a [probably a taxidermist's memorandum]. Brit. Mus. Reg. . ... | Onops californiana (Shaw) | Type | Loc. California. Pres. by A. Menzies." The above information supplied me by Mr. Harry S. Swarth (MS) who examined this specimen in London, May 12, 1930.

This is the basis of the figures by Shaw and Nodder and by Temminck (*teste* Sharpe, Cat. Birds British Mus., **1**, 1874, p. 29).

Type locality: "This Vulture was brought over by Mr. [Archibald] Menzies, during his expedition with Captain Vancouver, from the coast of California, and is now in the British Museum" (Shaw and

Nodder, *loc. cit.*). We learn from Menzies' California journal recently printed (Eastwood, Calif. Hist. Soc. Quart., **2**, 1924, pp. 265–340) that this naturalist, while stopping at several points on the Californian seacoast, and repeatedly at some of them, evidently found most opportunity for preserving specimens while he was at Monterey November 26, 1792, to January 14, 1793. According to his journal of date December 5, 1792 (*loc. cit.*, p. 286), for example, he mentions shooting, between the Presidio (of Monterey) and "Punta de Pinos" a number of birds including "a new species of Hawk . . .". And further he says he was occupied "the two following days . . . examining drawing & describing my [his] little collection & such other objects of natural history as were brought me [him] by the different parties [from the ship Discovery] who traversed the Country, & who were in general extremely liberal in presenting me [him] with every thing rare or curious they met with."

Taking both Menzies' journal and Vancouver's account (Voyage of Discovery, 3 vols., 1798) into account, together with the fact of known occurrence of California Condors in the early days commonly in the neighborhood, we are pretty safe in definitely determining the type locality as MONTEREY, Monterey County.

Elanus leucurus majusculus Bangs and Penard, Proc. New England Zoological Club, **7**, February 19, 1920, pp. 46–47.

[=*Elanus leucurus majusculus* Bangs and Penard.]

Type, male adult; skin in good condition; collected by Charles A. Allen, December 1, 1883; at one time no. 915 coll. E. A. and O. Bangs; now no. 100915, Museum of Comparative Zoology. [Examined by me February 3, 1922.]

Type locality, SAN RAFAEL, Marin County.

Buteo cooperi Cassin, Proc. Acad. Nat. Sci. Phila., **8**, "October, 1856" [=April 25, 1857], p. 253.

[=*Buteo borealis harlani* (Audubon).]

Type, "♂"; skin, in good condition, taken down from mount; collected by Dr. James G. Cooper, November 10, 1855 [not "October, 1856," as given in some places] (see Cooper, Pac. R. R. Repts., **12**, Book 2, Part 3, No. 3, 1860, p. 148); no. 8525, U. S. Nat Mus. [Examined by me last, forwarded, May 21, 1930.] (For critical account of this specimen, see Grinnell, Condor, **32**, 1930, p. 259.)

Type locality: "Santa Clara, Cal." on oldest Cooper-written label. Cooper himself (Orn. Calif., 1870, p. 473) says: "The type specimen I shot near Mountain View, Santa Clara Valley, California . . . "; hence MOUNTAIN VIEW, Santa Clara County.

Buteo elegans Cassin, Proc. Acad. Nat. Sci. Phila., **7**, "February" [=May 22], 1855, pp. 281–282.

[=*Buteo lineatus elegans* Cassin.]

Type, [probably female, rather than "♂"] adult; skin in excellent condition, unworn plumage, taken down from mount; collected by Dr. A. L. Heermann [within the period, 1849–52]; no. 1544, Acad. Nat. Sci. Phila. [Examined by me, October 19, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 29.)

Type locality, "California." Since Heermann says (Journ. Acad. Nat. Sci. Phila., ser. 2, **2**, 1853, p. 259) that the birds gathered by him during his first three-years' sojourn in California were collected "principally in the vicinity of Sacramento city," restriction may appropriately be made here to SACRAMENTO, Sacramento County, as the type locality.

Falco (Buteo) ferrugineus Lichtenstein, Abhand. Königl. Akad. Wiss. Berlin, 1838 (1839), p. 428.

[= *Buteo regalis* (Gray).]

Type, female; a mounted bird, in good condition; shot by Ferdinand Deppe, at Monterey, in December, 1834; now no. 618 in the Zoological Museum of the University of Berlin (*fide* Dr. E. Stresemann, in letters of January 28 and April 7, 1930).

Type locality, "California"; more exactly, MONTEREY, Monterey County.

Buteo Californica Grayson, Hutchings' Calif. Mag., **1**, March, 1857, pp. 393–396, fig. in text.

[= *Buteo regalis* (Gray).]

Type: No specimen preserved by the describer, Andrew Jackson Grayson, insofar as I have been able to learn. The drawing referred to below was probably made from a freshly killed bird in the fall of 1856 (see Bryant, Zoe, **2**, 1891, p. 40).

Type locality, "California"; more precisely, the "Valley of San Jose" where, says Grayson (*loc. cit.*, p. 395), "I [he] made the drawing of the one figured on the opposite page [p. 394]." Hence, vicinity of SAN JOSE, Santa Clara County.

Falco nigriceps Cassin, Illustr. Birds Calif., Texas, etc., "December, 1853" [issued certainly by or before February 7, 1854], p. 87.

[*Falco peregrinus anatum* Bonaparte.]

Type, at one time in the Philadelphia Academy, no. 2072 (*fide* Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 29); but not now to be found (Stone, in letter of January 7, 1930). The data given by Stone is "Bear creek, Cal. Kern." "Bear creek, California, (Mr. E. M. Kern.)" is the first locality given by Cassin (*loc. cit.*) under "Hab." There is thus no doubt but that this was the specimen so mentioned under the original description of the supposed new species. Edward M. Kern was a topographer and artist who accompanied John C. Fremont on his expedition of 1845–46, in the latter of which years one of the constituent parties was camped for some time on Bear River, 30 miles or so north of Sutter's Fort.

Ridgway (*in* Baird, Brewer and Ridgway, Hist. N. Am. Birds, **3**, 1874, p. 135) indicates as type of Cassin's "*nigriceps*," no. 13,856, U. S. Nat Mus., from Chile. This specimen is still in the National Museum (*fide* C. W. Richmond, in letter of June 5, 1930). But that it is not the true type is, I think, fully shown by the following facts.

While Cassin gave the "Hab." of "*nigriceps*" as extending to Chile, a study of the description and remarks shows that it was his intention to separate a western North American species from the one

of eastern North America, rather than a South American from a North American species. This interpretation is the one expressed by Sharpe (Cat. Birds British Mus., **1**, 1874, p. 381), and which had led him previously (Annals Mag. Nat. Hist., ser. 4, **11**, March, 1873, pp. 223–224) to name the Chilean form *Falco cassini*. This action, alone, by Sharpe, would seem to fix the name *nigriceps* on a North American bird, for it antedates Ridgway's published designation of a South American "type" by at least one year. Furthermore, modern authors use the name *cassini* for the Chilean race, for example, Brabourne and Chubb (List Birds S. Am., 1912, p. 72); Sharpe's ruling has thus been confirmed, doubtless on basis of re-examination of the evidence. Therefore:

Type locality, BEAR RIVER, at a point not far from confluence with Feather River, about due north of Sacramento, in Sutter or Yuba County.

Dendragapus obscurus sierræ Chapman, Bull. Am. Mus. Nat. Hist., **20**, April 25, 1904, p. 159.

[= *Dendragapus fuliginosus sierrae* Chapman.]

Type, male, probably about one year old; skin in fair condition; collected by Perry O. Simons [for William W. Price], July 18, 1896; now no. 79079, American Museum of Natural History. [Examined by me January 16, 1922.]

Type locality, ECHO [altitude 5700 feet, near head South Fork American River], Eldorado County.

Tetrao Californica [May], California Game "Marked Down" (Southern Pacific Co.), 1896, p. 41, fig.

[= *Dendragapus fuliginosus sierrae* Chapman.]

Type, none designated, and probably no specimen that can properly be called a type exists. The name is not available for use because of the preceding *Tetrao californicus* Shaw and Nodder.

Type locality, not stated, but can be inferred from context to be in the LAKE TAHOE region of the Sierra Nevada, in Eldorado County.

Dendragapus obscurus howardi Dickey and van Rossem, Condor, **25**, September [= October 3], 1923, p. 168.

[= *Dendragapus fuliginosus howardi* Dickey and van Rossem.]

Type, male adult, in "breeding condition"; skin in good condition; collected by A. J. van Rossem, May 28, 1922; orig. no. 6931, A. J. van R.; now no. K 238, coll. Donald R. Dickey. [Examined by me, last, April 15, 1930.]

Type locality, MOUNT PINOS, [north side] at 7500 feet altitude, in Kern County.

Tetrao californicus Shaw and Nodder, Naturalist's Miscellany, **9**, 1797 [1798], pl. 345 and accompanying text.

[= *Lophortyx californica californica* (Shaw and Nodder).]

Type, once in British Museum; not now known to be in existence, and probably long ago destroyed. (See Sharpe, *in* Hist. Colls. Nat. Hist. Depts. British Mus., **2**, 1906, pp. 79ff.)

Type locality: "This curious bird is a native of California, and was brought over by Mr. Archibald Menzies, who accompanied Captain Vancouver in his late expedition. The specimen from which the present figure was taken is in the British Museum" (Shaw and Nodder, *loc. cit.*). It becomes clear from a study of Vancouver's account (Voyage of Discovery, 3 vols., 1798) and especially of Menzies' journal (Eastwood, Calif. Hist. Soc. Quart., **2**, 1924, pp. 265–340) that as among the several localities on the west coast visited by Menzies, Monterey fulfills best the conditions for the collecting of the specimens of this species brought back to England. The matter is practically clinched, even as to date of capture, by the following statements in Menzies' journal (*loc. cit.*, p. 286). Under date December 5, 1792, he records strolling out from the Presidio (of Monterey) "towards Punta de Pinos" and seeing, besides many plants of interest to him, a "great variety of the feathered Tribe, many of which were also new, among these" being a "species of Quail of a dark lead colour," etc., describing it further, and mentioning also that he had met with it at Port San Francisco. Further down on the same page Menzies says: "The two following days I remained on board [the ship Discovery] examining drawing & describing my little collection & such other objects of natural history as were brought me by the different parties [from the ship] who traversed the Country . . . ".

The type locality of the California Quail can thus now be stated quite positively as MONTEREY, Monterey County.

Callipepla californica vallicola Ridgway, Proc. U. S. Nat. Mus., **8**, September 2, 1885, p. 355.

[= *Lophortyx californica californica* (Shaw and Nodder).]

Type, male adult; skin in excellent condition; collected by Charles H. Townsend, May 24, 1883; orig. no. 67; now no. 91767, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality, "interior valleys" of California; later, restricted to BAIRD [near mouth of McCloud River], Shasta County (see A. O. U. Check-list, 3rd ed., 1910, p. 136), whence came what was subsequently selected as the type specimen.

Note.—For reasons for synonymizing the heretofore current name *vallicola* of Ridgway under Shaw and Nodder's name *californica*, see Grinnell, Condor, **33**, 1931, pp. 37–38.

Lophortyx californicus brunnescens Ridgway, Proc. Biol. Soc. Wash., **2**, April 10, 1884, p. 94.

[= *Lophortyx californica brunnescens* Ridgway.]

Type, male adult; skin in good condition save for broken left leg; in exceedingly fresh, unworn and unfaded plumage, molt of outermost primaries incomplete (hence a September-taken bird); the oldest label is in S. F. Baird's hand-writing, and indicates that the bird was taken at "Santa Barbara California 6 March 1837" by "J. K. T." (that is, supposedly, by or for John K. Townsend). This is in exact accord with the statement of Audubon (Birds Am., **5**, 1842, p. 67); possibly it was this source from which Baird took the data he put on

the label he wrote. The skin is now no. 2829, U. S. National Museum [examined by me last, forwarded, November 29, 1930].

This bird had thus, supposedly, passed from Townsend through Audubon's hands to Baird, before the present oldest label was written. The characters of the skin show indubitably that it could not have come from Santa Barbara as stated by Audubon (*loc. cit.*). Also Townsend himself was in the Hawaiian Islands on the date given, and never was in California at all, in so far as I can learn; the month given, too, is impossible for the plumage condition of the bird bearing this label. It is well known that the data accompanying Townsend's specimens were, in many cases, erroneous (*fide* Ridgway, *loc. cit.*); it is even not certain that any of them were supplied with labels before leaving Townsend's hands (see Stone, Auk, **47**, 1930, p. 415). That the bird could have come from near the mouth of the Columbia River, as suggested by Ridgway, is for several reasons not at all likely. There is no comparable skin from anywhere north of California in either the National Museum or the Museum of Vertebrate Zoology; nor can I match it with any skin from south of Santa Cruz County, California. The type falls in accurately with skins from the San Francisco Bay region. The real collector of the specimen is unknown.

Type locality, "Santa Barbara, California"; but, for reasons given above, with little doubt SAN FRANCISCO, San Francisco County.

Lophortyx catalinensis Grinnell, Auk, **23**, July, 1906, p. 262.

[=*Lophortyx californica catalinensis* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, November 25, 1904; orig. no. 6134, coll. J. G.; now no. 32040, Mus. Vert. Zool.

Type locality, [the cañon immediately back of] Avalon, SANTA CATALINA ISLAND, Los Angeles County.

Callipepla gambeli deserticola Stephens, Auk, **12**, October, 1895, p. 371.

[=*Lophortyx gambelii gambelii* Gambel.]

Type, male [not "♀"] adult; skin in good condition; collected by Frank Stephens, January 15, 1890; orig. no. 4969, F. S.; now no. 264, coll. San Diego Society of Natural History. [Examined by me January 7, 1930; forwarded.] A female "type" is also designated in the original description, from "Walters" [=Mecca], Colorado Desert, Riverside County; but the first-designated specimen is here considered *the* type, and hence its place of capture *the* type locality, as below.

Type locality, PALM SPRINGS, "100" [=450] feet altitude, Colorado Desert, Riverside County.

Rallus elegans, var. **obsoletus** Ridgway, Am. Naturalist, **8**, February, 1874, p. 111.

[=*Rallus obsoletus obsoletus* Ridgway.]

Type, skin, in fair condition, taken down from mount; [sex ?] seemingly old adult; collected by Dr. George Suckley in March, 1857; no. 6444, U. S. Nat. Mus. [Examined by me October 26, 1929.]

Type locality, SAN FRANCISCO, San Francisco County.

Rallus levipes Bangs, Proc. New England Zool. Club, **1**, June 5, 1899, p. 45.

[= *Rallus obsoletus levipes* Bangs.]

Type, female adult; skin in good condition; collected by Frank Stephens, February 23, 1886; orig. no. 2944, coll. F. S.; then no. 678 coll. E. A. and O. Bangs [examined by me February 3, 1922]; now no. 100678, Mus. Comp. Zool. (*fide* Bangs, Bull. Mus. Comp. Zool., **70**, 1930, p. 167).

Type locality, NEWPORT LANDING, "Los Angeles County" [= Orange County].

Rallus yumanensis Dickey, Auk, **40**, January [10], 1923, p. 90.

[= *Rallus obsoletus yumanensis* Dickey.]

Type, male adult; skin in good condition; collected by May Canfield, May 15, 1921; orig. no. 229, coll. L. M. Huey; now no. J 1039, coll. Donald R. Dickey. [Re-examined by me, April 15, 1930.]

Type locality, valley of lower Colorado River, near BARD, Imperial County.

Rallus virginianus pacificus Dickey, Condor, **30**, September 28, 1928, p. 322.

[= *Rallus limicola pacificus* Dickey.]

Type, male, in first winter plumage; skin in good condition; collected by A. J. van Rossem, December 21, 1913; orig. no. 5967, coll. A. B. Howell; now no. 11337, coll. Donald R. Dickey. [Examined by me April 15, 1930.]

Type locality, five miles west of CORONA, Riverside County.

Porzana Jamaicensis, var. **coturniculus** Ridgway, Am. Naturalist, **8**, February, 1874, p. 111.

[= *Creciscus jamaicensis coturniculus* (Ridgway).]

Type, [sex ?], apparently in first fall plumage (see comments by Brewster, Auk, **24**, 1907, p. 207); skin in poor condition, taken down from mount; no original data; registered at the Smithsonian Institution, October 13, 1859; received from, though not necessarily collected by, T. C[originally published "G"]. Martin; now no. 12862, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality, FARALLON ISLANDS, San Francisco County.

Aegialitis nivosa Cassin, *in* Baird, Pac. R. R. Repts., **9**, 1858, p. 696.

[= *Charadrius nivosus nivosus* (Cassin).]

Type, [sex ?], skin; collected by Lieut. W. P. Trowbridge, May 8, 1854; once no. 6600, U. S. Nat. Mus. (see Stone, Proc. Acad. Nat Sci. Phila., 1899, p. 29). Not now there; the National Museum records show that this specimen was sent to Henry E. Dresser, of England, May 20, 1872 (*fide* C. W. Richmond, MS).

The Dresser collection found its way into the Victoria University, Manchester (Sharpe, *in* Hist. Colls. Nat. Hist. Depts. British Mus., **2**, 1906, p. 340). I inquired of the present Keeper of the Manchester Museum, Dr. G. H. Carpenter, who thereupon with the kindly assistance of Mr. T. A. Coward instituted search for this type. Under date February 5, 1931, Dr. Carpenter writes me that no trace of the speci-

men can be found. The Dresser collection reached the Museum in 1898, and it is suggested that, during the 26 years gone by since the type in question was transmitted from the U. S. National Museum, Dresser may have exchanged it or given it elsewhere, not realizing its special value.

Type locality, Presidio, in San Francisco, San Francisco County.

Strepsilas melanocephalus Vigors, Zool. Journ., **4**, [January,] 1829, p. 356.

[= *Arenaria melanocephala* (Vigors).]

Type: "Two specimens of this bird were . . . brought home by the expedition" (Vigors, Zool. Voyage Blossom, 1839, p. 29). Neither now known to me to exist; apparently not in the British Museum, where they might be expected to be (*fide* P. R. Lowe, *in litt.,* March 18, 1930).

Type locality, not given in connection with the original description, nor elsewhere that I know of. From among the localities visited by the Blossom, the most likely one, all things considered, from which this species could have been obtained, is Monterey, Monterey County; and this place I therefore now fix as the type locality. The Blossom was there twice, January 1 to 5, 1827, and October 29 to November 17, 1827. The collector of the two specimens "brought home" was doubtless surgeon Alexander Collie.

Ereunetes occidentalis Lawrence, Proc. Acad. Nat. Sci. Phila., "April" [by June 30], 1864, p. 107.

[= *Ereunetes mauri* Cabanis.]

Type, male, in first nuptial plumage; skin in fair condition. The original Gruber-written label, on ruled blue paper, reads on one side as follows: "Least Sandpiper male. | Tringa Wilsonii. Nuttall. | Collected April 1862 by F. Gruber. | 542 Clay St. below Montgomery. | San Francisco, Cal."; measurements, etc., on other side. Another label is that of "Coll. Geo. N. Lawrence." This bears additionally to part of the above data the word "Type" and also the number "535." Now no. 45562, coll. American Museum of Natural History, New York City. [Forwarded and examined by me, November 2, 1930.]

Type locality, "Pacific coast; California, Oregon" (Lawrence, *loc. cit.*). More exactly, from above evidence, San Francisco, San Francisco County.

Recurvirostra occidentalis Vigors, Zool. Journ., **4**, [January,] 1829, pp. 356–357.

[= *Recurvirostra americana* Gmelin.]

Type, not known to me to be now in existence; it might have once been in the British Museum, but it is not there now (*fide* P. R. Lowe, *in litt.,* March 18, 1930).

Type locality: "It was found abundantly at San Francisco" (Vigors, Zool. Voyage Blossom, 1839, p. 28). This was during the visits of the Blossom to that place, November 7 to December 28, 1826, and November 19 to December 3, 1827. The bird figured in the Zoology of the Voyage of the Blossom (pl. 12) is in winter plumage and was doubtless collected during one of those visits, by surgeon Alexander Collie. Hence San Francisco, San Francisco County.

Larus occidentalis wymani Dickey and van Rossem, Condor, **27**, July 15, 1925, p. 163.

[= *Larus occidentalis wymani* Dickey and van Rossem.]

Type, male adult; skin in excellent condition; collected by A. J. van Rossem, May 22, 1925; orig. no. 8329, coll. A. J. van R.; now no. 15250, coll. Donald R. Dickey. [Examined by me April 15, 1930.]

Type locality, SANTA CATALINA ISLAND, Los Angeles County. More exactly, the small flat islet on the northwest side of this island, just off the cove at the "isthmus" (A. J. van Rossem, MS).

Larus Californicus Lawrence, Annals Lyc. Nat. Hist. New York, **6**, March, 1854, pp. 79–80.

[= *Larus californicus* Lawrence.]

Type, male adult, in winter plumage; skin in fair condition though dirty. The oldest of the three labels bears data as follows: "Coll. Geo. N. Lawrence [printed] | Larus californicus ♂ | California 663 [the Baird Catalogue number] || Presented by | E. S. Holden | — Type — ." Now no. 46070, American Museum of Natural History. [Forwarded and examined by me May 3, 1930.] "The specimen described was presented to me by E. S. Holden, Esq., who shot it on the San Joachin River, near Stockton" (Lawrence, *loc. cit.*).

Type locality, San Joaquin River near STOCKTON, San Joaquin County.

Larus Heermanni Cassin, Proc. Acad. Nat. Sci. Phila., **6**, "October" [= December 31], 1852, p. 187.

[= *Larus heermanni* Cassin.]

Type, "cannot be found" (*fide* Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 28). ". . . Discovered by Adolphus L. Heermann, M. D.," probably in 1851; found "most numerous in the harbor of San Diego in the month of March . . ." (Cassin, Illustr. Birds Calif., Texas, etc., 1856, p. 28). Evidently several specimens were preserved by Heermann; adult and immature are shown on Cassin's plate 5 (*op. cit.*).

Type locality, "coast of California at San Diego." Hence, SAN DIEGO, San Diego County.

Gelochelidon nilotica vanrossemi Bancroft, Trans. San Diego Soc. Nat. Hist., **5**, December 10, 1929, p. 284.

[= *Gelochelidon nilotica aranea* (Wilson).]

Type, male adult, "breeding"; skin in good condition; collected by A. J. van Rossem, May 21, 1928; orig. no. 12278; now no. 22838, coll. Donald R. Dickey. [Examined by me April 15, 1930.]

Type locality, an island in SALTON SEA, Imperial County.

Sterna Pikei Lawrence, Annals Lyc. Nat. Hist. New York, **6**, April, 1853, p. 3.

[= *Sterna paradisaea* Brünnich.]

Type, "from the cabinet of Nicolas Pike, Esq., of Brooklyn, L. I. . . . ". It evidently passed into the possession of George Newbold Lawrence; for Coues (Proc. Acad. Nat. Sci. Phila., 1862, p. 550)

states that he had then before him "the original of Mr. Lawrence's descriptions (l. c.) obligingly furnished by that gentleman for examination." Coues further says in the same place that this specimen, "the only one known to exist in any cabinet, is unfortunately in immature or winter plumage, and in rather poor condition." I have been unable, after a considerable amount of enquiry, to trace farther the fate of this type, or to learn any details regarding its capture. A mere suggestion is that it might have been obtained by John G. Bell in 1849.

Type locality, "near the coast of California, in the vicinity of Monterey" (Lawrence, *loc. cit.*). Hence MONTEREY, Monterey County.

Sterna antillarum browni Mearns, Proc. Biol. Soc. Wash., **29**, April 4, 1916, pp. 71–72.

[= *Sterna antillarum browni* Mearns.]

Type, male adult; skin in excellent condition; collected by Edgar A. Mearns, July 12, 1894; orig. no. 11259; now no. 134773, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, near Monument No. 258, Mexican Boundary Line, on the edge of the Pacific Ocean in San Diego County, not far from SAN DIEGO.

Catarractes Californicus H. Bryant, Proc. Boston Soc. Nat. Hist., **8**, July [probably printed somewhat later], 1861, p. 142.

[= *Uria aalge californica* (H. Bryant).]

Type, none originally designated. The assumed type was once in the U. S. National Museum and supposedly no. 17402, a skin doubtless taken by or for the San Francisco taxidermist, Ferdinand Gruber, probably in the early summer of 1860; but this skin cannot now be found, having probably been given away or exchanged under a policy of "distribution" obtaining under the Bairdian regime.

The describer, Henry Bryant, says (*op. cit.*, p. 134) that he had before him, in addition to his own specimens, "the whole series belonging to the Smithsonian Institution." The drawing of bill "No. 3. C. californicus, adult" (p. 135) ought, in absence of any other indication, to be considered as of the type specimen. Matching of bills might once have served to settle this, only Bryant's comment (p. 143, footnote) indicates that certain inaccuracies were introduced by the engraver.

A specimen still in the National Museum (forwarded and before me April 5, 1930) matches very closely the drawing in question, save that the tip of the bill is broken. This is no. 17407, male, breeding bird with "egg-pocket," skin in fair condition, taken by or for F. Gruber. That this is quite surely one of the skins that was in Bryant's hands, and hence at least a cotype, is shown by one of the four labels it bears (not the original, oldest one) having written on it "iris white." For this is commented upon by Bryant, and [properly] discredited; he says "according to the labels, the iris is white."

Type locality, "Farrellones Islands, near San Francisco, Cal." = the FARALLON ISLANDS, San Francisco County.

Mergulus Cassinii Gambel, Proc. Acad. Nat. Sci. Phila., **2**, "August" [= December 5], 1845, p. 266.

[= *Ptychoramphus aleuticus* (Pallas).]

Type, skin in unfaded, clean condition, taken down from mount; adult [sex ?], taken probably in breeding season; collected by or for William Gambel; no. 30073, Acad. Nat. Sci. Phila. [Examined by me October 18, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 19.)

Type locality, "coast of California"; likely on or near SANTA CATALINA ISLAND, Los Angeles County, where Gambel states (Journ. Acad. Nat. Sci. Phila., **1**, 1847, p. 26) that he found Fish Hawks nesting in February [1842 ?] "on the precipitous cliffs." [In this connection, see Stephens, Auk, **10**, 1893, p. 298.]

Columba monilis Vigors, Zool. Voyage Blossom, 1839, p. 26, pl. 10.

[= *Columba fasciata fasciata* Say.]

Type, not now known to exist; probably once in the British Museum, but not to be found there now (*fide* P. R. Lowe, *in litt.,* March 18, 1930).

Type locality, MONTEREY, Monterey County. Found there, doubtless by surgeon Alexander Collie, during the visits of the Blossom, January 1 to 5, 1827, and October 29 to November 17, 1827.

Saurothera californiana Lesson, "Compl. Œuvres Buffon, **6**, 1829, p. 420."

[= *Geococcyx californianus* (Lesson).]

Type, collected by Paolo Emilio Botta, surgeon on the ship Heros which visited various ports in California in 1827 and 1828. The type specimen was once in the Rivoli collection, but where it is now I have not learned. It is not in the Paris Museum of Natural History (*fide* Mr. J. Berlioz, *in litt.,* May 5, 1930), nor is it in the Philadelphia Academy (*fide* Dr. Witmer Stone, *in litt.,* August 23, 1930).

Type locality: Only "La Californie" given in connection with the original description. Dr. T. S. Palmer (Condor, **19**, 1917, p. 160) has worked out the probabilities in the case, from a study of the narrative of the voyage. He concludes that the road-runner was collected in southern California, and, from the places mentioned in the itinerary which he presents, "the type locality may reasonably be assumed as the vicinity of Los Angeles or San Diego." Since three stops are recorded for San Diego and only two (inland) visits to Los Angeles, and since the total time spent at San Diego appears to have been the longer, I hereby select SAN DIEGO, San Diego County, as the restricted type locality.

Saurothera Bottae Lesson, Traité d'Ornithologie, 1831, p. 145.

[= *Geococcyx californianus* (Lesson).]

Type, at the time of the description, in the museum of the Duke of Rivoli. The species was "découvert à la Californie par M. Botta . . ." (Lesson, *loc. cit.*). Type thus doubtless the same as for *Saurothera californiana* Lesson, which see.

Type locality, same as for *Saurothera californiana* Lesson, namely, for reasons stated under that heading, SAN DIEGO, San Diego County.

Scops asio bendirei Brewster, Bull. Nuttall Orn. Club, **7**, January, 1882, p. 31.

[= *Otus asio bendirei* (Brewster).]

Type, female adult, skin in excellent condition; collected by Charles A. Allen, April 24, 1877; no. 1546, coll. William Brewster; now no. 201546, Mus. Comparative Zoology. [Examined by me October 15, 1930.]

Type locality, NICASIO, Marin County.

Otus asio quercinus Grinnell, Auk, **32**, January 1, 1915, p. 60.

[= *Otus asio quercinus* Grinnell.]

Type, male adult, skin in good condition; collected by J. Grinnell, April 21, 1904; orig. no. 5678, coll. J. G.; now no. 32339, Mus. Vert. Zool.

Type locality, PASADENA [type taken on old Grinnell home place, 572 north Marengo Avenue], Los Angeles County.

Otus asio inyoensis Grinnell, Auk, **45**, April 16, 1928, pp. 213–214.

[= *Otus asio inyoensis* Grinnell.]

Type, female adult, in full fresh annual plumage; skin in excellent condition; collected by Norman Clyde, October 13, 1927; prepared by J. Grinnell; no. 51391, Mus. Vert. Zool.

Type locality, within the town of INDEPENDENCE, Owens Valley, Inyo County.

[**Bubo virginianus.**] Variety, **pacificus** Cassin, Illustr. Birds Calif., Texas, etc., "July" [certainly not later than September 12], 1854, p. 178.

[= *Bubo virginianus pacificus* Cassin.]

Type, none until now designated from such specimens as Cassin may have handled, in either the Philadelphia Academy or National Museum series. Cassin ascribes his new "variety" merely to "the west." Habitat subsequently restricted, by the action of Ridgway (1877) in naming *B. v. saturatus*, and by Stone (Auk, **13**, April, 1896, p. 155), to "southern California." Later still, Stone (Proc. Acad. Nat. Sci. Phila., 1899, p. 30) considers himself to have "restricted" the type locality further by designating no. 27905, Acad. Nat. Sci. Phila., as "the typical specimen." This is a male, taken by R. B. Herron at San Bernardino, in April, 1887 [skin, in good condition, examined by me October 19, 1929].

But this bird is, of course, not a true type, which must be selected not only in the light of Cassin's descriptive remarks, but from among the birds he had before him at the time of description; the only western localities given by him under the habitat of the species *virginianus* are: "Washington Territory (Dr. Cooper)," "Oregon (Dr. Townsend)," and "California (Dr. Heermann)." (See also list in Pac. R. R. Repts., **9**, 1858, p. 51; but only those collected previous to July, 1854, can be candidates for real typeship.)

In view of the above considerations, the only bird enumerated in the 1858 list of specimens that can now properly be selected as the type is no. 6886, U. S. Nat. Mus.; sex not recorded, collected by Dr. A. L. Heermann within the period 1849–52 [probably in the autumn of

1849], at Sacramento, and later transmitted to the Smithsonian by Lt. R. S. Williamson. This is in accordance with the record in the Smithsonian register, in which, Dr. C. W. Richmond points out to me, is the further comment, "Sent to Mombusho Mus., Tokio, in 1877." I am informed by Dr. N. Kuroda (letter of December 24, 1930) that some forty years ago the property of that museum was turned over to the Tokyo Museum (now the Tokyo Scientific Museum), but effort there has failed of finding any trace of the type in question. Dr. Kuroda tells me further (letter of April 18, 1931) that the catalogues of specimens were destroyed in the great fire of 1923, though many of the specimens themselves were saved.

Type locality, within the limits of the present city of SACRAMENTO, Sacramento County. (For comments bearing on this point, see Heermann, Journ. Acad. Nat. Sci. Phila., ser. 2, **2**, 1853, p. 261.)

Note.—This determination in no way changes the current concept of the subspecies, or the application to it of the name *pacificus*.

Asio magellanicus icelus Oberholser, Proc. U. S. Nat. Mus., **27**, January 22, 1904, p. 185.

[= *Bubo virginianus pacificus* Cassin.]

Type, female [not "adult," but in first-year plumage—down filaments still adhering to many contour feathers]; skin in good condition; collected by Edward W. Nelson, November 29, 1891; no. 141225, U. S. Nat. Mus. (Biol. Surv. coll.). [Examined by me October 30, 1929.]

Type locality, SAN LUIS OBISPO, San Luis Obispo County.

Glaucidium gnoma grinnelli Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 6, 1914, p. 791.

[= *Glaucidium gnoma grinnelli* Ridgway.]

Type, male adult, in full unworn and unfaded plumage; skin in good condition; collected by Charles H. Townsend, November 28, 1885; orig. no. 1356; now no. 107389, U. S. Nat Mus. [Examined by me October 29, 1929.]

Type locality, Humboldt Bay; more exactly, near mouth of MAD RIVER, Humboldt County (C. H. Townsend, MS).

Glaucidium californicum Sclater, Proc. Zool. Soc. London, [May 26,] 1857, p. 4.

[= *Glaucidium gnoma californicum* Sclater.]

Type, female; skin, though taken down from mount, in excellent condition; adult in unworn plumage, hence probably taken in fall or early winter; collected by Dr. A. L. Heermann in 1852; no. 2559, Acad. Nat. Sci. Phila. [Examined by me October 19, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 24.) A note on the back of the label reads: "This was the bird examined by Sclater in 1856 and must be considered the type of his *G. californicum* [W. S.]."

Type locality, "California"; doubtless "borders of the" CALAVERAS RIVER [in vicinity of "southern mines," well up in foothills of Sierra Nevada, in Calaveras County] where Heermann (Journ. Acad. Nat. Sci. Phila., ser. 2, **2**, 1853, p. 260) says he found this species and obtained three specimens of it.

Glaucidium gnoma vigilante Grinnell, Auk, **30**, April [published March 31], 1913, p. 224.

[= *Glaucidium gnoma californicum* Sclater.]

Type, female adult; skin in good condition; collected by J. Grinnell, February 18, 1894; orig. no. 379, coll. J. G.; now no. 32379, Mus. Vert. Zool.

Type locality, in foothills [Millard Cañon], 2250 feet altitude, four miles north of PASADENA, Los Angeles County.

Speotyto cunicularia obscura Stephens, Auk, **12**, October, 1895, p. 372.

[= *Speotyto cunicularia hypugaea* (Bonaparte).]

Type, female adult, in somewhat worn plumage; skin in fair condition; collected by Frank Stephens, May 29, 1894; orig. no. 5874; now no. 151022, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality, UPPER LAKE, Lake County.

Syrnium occidentale Xantus, Proc. Acad. Nat. Sci. Phila., "July, 1859" [by January 10, 1860], pp. 190, 193.

[= *Strix occidentalis occidentalis* (Xantus).]

Type, male adult; skin, in fair condition, taken down from mount; collected by John Xantus, March 6, 1858; orig. no. 1588; now no. 17200 U. S. Nat. Mus. [Examined by me, October 30, 1929.]

Type locality: Type taken at FORT TEJON, Kern County; so stated by Xantus himself.

Strix frontalis Lichtenstein, Abhand. Köngl. Akad. Wiss. Berlin, 1838 (1839), p. 430.

[= *Cryptoglaux acadica acadica* (Gmelin).]

Type, a mounted bird, male [evidently in juvenile stage of plumage], in good condition; collected by Ferdinand Deppe at Monterey, presumably in December, 1834; now no. 1294 in the Zoological Museum of the University of Berlin (*fide* Dr. E. Stresemann, in letter of January 28, 1930).

Type locality, "California"; more exactly, MONTEREY, Monterey County.

Phalaenoptilus nuttallii californicus Ridgway, Manual N. Am. Birds, 1887 [later than August 20], p. 588, footnote.

[= *Phalaenoptilus nuttallii californicus* Ridgway.]

Type, female adult; skin in excellent condition; collected by Charles A. Allen, April 7, 1884; no. 108372, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, NICASIO, Marin County.

Phalaenoptilus nuttallii hueyi Dickey, Condor, **30**, March 15, 1928, p. 152.

[= *Phalaenoptilus nuttallii hueyi* Dickey.]

Type, female, adult; skin in excellent condition; collected by May Canfield and Laurence M. Huey, May 8, 1921; orig. no. 163; now no. J 973, coll. Donald R. Dickey. [Forwarded and examined by me November 7, 1930.]

Type locality, BARD, altitude 140 feet, Imperial County.

Chordeiles virginianus hesperis Grinnell, Condor, **7**, November 22, 1905, p. 170.

[=*Chordeiles minor hesperis* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell and J. Dixon, July 30, 1905; orig. no. 6917, coll. J. Grinnell; now no. 32797, Mus. Vert. Zool.

Type locality, [south shore of] BEAR LAKE, 6700 feet altitude, San Bernardino Mountains, San Bernardino County.

Trochilus violajugulum Jeffries, Auk, **5**, April, 1888, p. 168.

[=probable hybrid between *Archilochus alexandri* (Bourcier and Mulsant) and *Calypte anna* (Lesson).]

Type, male adult; skin in good condition (terminal third of upper mandible gone); collected by J. Amory Jeffries, April 5, 1883; orig. no. 1616, J. A. Jeffries of Boston; now no. 10932, Mus. Comparative Zoology. [Examined by me October 15, 1930.]

Type locality, SANTA BARBARA, Santa Barbara County; "a bushy field at the base of the flower belt, well up the foothills" (Jeffries, *loc. cit.*).

Ornismya Anna Lesson, Hist. Nat. Oiseaux-Mouches, 1829, pp. xlvi, 205, pl. 74.

[=*Calypte anna* (Lesson).]

Type, collected by the young doctor [Paolo Emilio] Botta; passed into possession of the Duke of Rivoli, and apparently later went through the hands of Lesson. Mr. J. Berlioz tells me (*in litt.*, May 5, 1930) that he thinks the type might now be in the Rochefort Museum, "where are many of Lesson's types." This type is not in the Philadelphia Academy, as has been supposed by some writers (*fide* Dr. Witmer Stone, *in litt.*, August 23, 1930).

Type locality: Nothing more definite than "la Californie" given in connection with the original description. Botta was surgeon on the ship Heros; Dr. T. S. Palmer (Condor, **19**, 1917, p. 160) has worked out Botta's itinerary while in California and concludes that "San Francisco may be accepted as the type locality of *Calypte anna* since Botta collected there longer than at other places and in the narrative of the voyage hummingbirds are especially mentioned among the birds obtained there in February, 1827." Thus Palmer may be considered to have fixed the type locality as SAN FRANCISCO, San Francisco County.

Trochilus icterocephalus Nuttall, Manual Orn., ed. 2, 1840, p. 712.

[=*Calypte anna* (Lesson).]

Type: description based on male, observed by Thomas Nuttall, himself, in [April,] 1836; but only a female was taken, he says. This specimen I have been unable to trace, though Audubon evidently saw it.

Gambel (Journ. Acad. Nat. Sci. Phila., **1**, 1847, p. 33) says that Nuttall "did not procure the male [of *T. icterocephalus*], but saw it frequently, and supposed it to have a yellow spot on the crown. I [Gambel says] discovered that that which deceived him in this respect was the glutinous pollen out of a tubular flower upon which it feeds,

adhering to the rigid feathers of the crown, and making it look as if it really had a yellow head."

Type locality, Santa Barbara, Santa Barbara County.

Ornismya Sasin Lesson, Hist. Nat. Oiseaux-Mouches, "Mai," 1829 [-1830], pp. xxx, 190–192, pl. 66.

[= *Selasphorus sasin sasin* (Lesson).]

Type: Of the two or more birds figured by Lesson as belonging to his species *sasin,* the first (pl. 66) is obviously an adult male Allen Hummingbird, and the main description fits it. This bird was doubtless from the Rivoli collection (see Grinnell, Condor, **33**, 1931, p. 77), and its collector was very likely surgeon P. E. Botta, of the ship Heros; thus it was probably taken in February, 1827, in the vicinity of San Francisco (see Palmer, Condor, **19**, 1917, p. 161). The fate of this type is unknown to me; it is not in the Philadelphia Academy.

Type locality: "La Californie, la côte N.-O. d'Amerique." By subsequent fixation, as above, San Francisco, San Francisco County.

Selasphorus alleni Henshaw, Bull. Nuttall Orn. Club, **2**, July, 1877, p. 53.

[= *Selasphorus sasin sasin* (Lesson).]

Type, no one specimen so designated in connection with original description. Three adult males are listed by Henshaw (*loc. cit.,* p. 57) in his accompanying table of measurements as being from the type locality. The first of these may, by arbitrary selection, be considered *the* type, and it is there recorded as collected by C[harles]. A. Allen, at Nicasio, March 24, 1875. These three birds evidently passed into the possession of the British Museum, in 1888, along with the rest of the Henshaw bird collection which had been sold by H. W. Henshaw to F. Du Cane Godman in 1885; for three adult males, "*a–c,*" are listed, along with juvenals and females, as from "Nicasio, California (*H. W. Henshaw*)" in volume 16 of the Catalogue of Birds in the British Museum (Salvin, 1892, p. 395).

Type locality, Nicasio, Marin County.

Note.—For reasons for supplanting the current name *alleni* of Henshaw with Lesson's name *sasin,* see Grinnell, Condor, **33**, 1931, pp.77–78.

Selasphorus alleni sedentarius Grinnell, Condor, **31**, September 16, 1929, p. 226.

[= *Selasphorus sasin sedentarius* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, April 2, 1897; orig. no. 2321, coll. J. G.; now no. 33018, Mus. Vert. Zool.

Type locality, Smuggler's Cove [= Pyramid Cove], San Clemente Island, Los Angeles County.

Colaptes collaris Vigors, Zool. Journ., 4, [January,] 1829, p. 354.

[= *Colaptes cafer collaris* Vigors.]

Type, a true one not certainly now to be designated. In the British Museum what has there been considered the type is a specimen as follows: British Mus. reg. no. 43.7.22.59; a skin in fair condition, not noticeably dirty or discolored; sex not of record, but in adult male

plumage [though "imm." appears on one of the labels] with outer primaries partly ensheathed and two middle rectrices about half grown; outer rectrices missing; molt apparently just beginning, hence the bird probably taken in July or August; the oldest label (not very old) in part reads: "Loc. San Francisco. Pres. by Sir E. Belcher" (*fide* H. S. Swarth, MS, May 9, 1930).

In Vigors' original description no mention of any locality is given; but his account in the Zoology of Captain Beechey's Voyage (1839, p. 24) is circumstantial; the notes of the collector, surgeon [Alexander] Collie, are given, wherein it is stated: "These birds were found at Monterey. . . . They are tolerably numerous among the pine trees between Monterey and Punta de los Pinos. . . ." The Blossom was at Monterey twice, January 1 to 5, 1827, and from October 29 to November 17, 1827; both visits were thus in midwinter, not in July or August. The plate (IX) in the work last cited is of a bird with complete set of rectrices, not in molt.

While it is quite possible that one or more red-shafted flickers were taken on the same voyage also at San Francisco, at which stops were made in November and December, of the two years, 1826 and 1827, such a bird could not, in view of the statements above made, be by subsequent action selected as *the* type, *unless* it could be shown that said statements were at fault in some way. The discrepancies concerning the plate, and the evident season of capture of the alleged "type," are again significant. Alternative possibilities suggest themselves, but they are too remote for presentation in want of additional facts. Enough is apparent to warrant the statement first made above, that a true type is not now known to exist.

Type locality, as according to above statements of Vigors, MONTEREY, Monterey County.

Melanerpes formicivorus bairdi Ridgway, U. S. Nat. Mus. Bull., **21**, [April,] 1881, pp. 34, 85.

[=*Balanosphyra formicivora bairdi* (Ridgway).]

Type, "♂" [more probably female], adult; skin in fairly good condition; collected by Emanuel Samuels in May, 1856; orig. no. 756; now no. 5495, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality, PETALUMA, Sonoma County [this by subsequent designation (A. O. U. Check-list, ed. 3, 1910, p. 193), since no locality was given in connection with the original naming].

Sphyrapicus varius daggetti Grinnell, Condor, **3**, January 15, 1901, p. 12.

[=*Sphyrapicus varius daggetti* Grinnell.]

Type, male adult, skin in good condition; collected by Frank S. Daggett, January 25, 1893; orig. no. 1482, coll. F. S. Daggett; for many years in Grinnell coll.; now no. 33732, Mus. Vert. Zool.

Type locality, PASADENA, Los Angeles County.

Picus thyroideus Cassin, Proc. Acad. Nat. Sci. Phila., **5**, "December, 1851" [=February 17, 1852], p. 349.

[=*Sphyrapicus thyroideus thyroideus* (Cassin).]

Type, female, adult; skin in good condition, taken down from mount; plumage unworn, so bird probably autumn or winter taken;

collected by John G. Bell [in 1849]; no. 24214, Acad. Nat. Sci. Phila. [Examined by me October 18, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 30.) Cassin says (Illustr. Birds Calif., Texas, etc., 1856, p. 202) that "Mr. Bell was the first naturalist who visited California after it became a portion of the United States; and during his stay in that country, made a large and highly interesting collection, in which was the present and other new species. He observes in his notes now before us, that he found this bird in one locality only, and observed but two specimens, both of which he obtained."

Type locality, "California." With scarcely any doubt from the same general neighborhood as the type of *Leuconerpes albolarvatus* Cassin (which see), taken by the same collector; thus, "near GEORGETOWN, about 12 miles from Sutter's mill," Eldorado County; hereby so fixed.

Melanerpes rubrigularis Sclater, Proc. Zool. Soc. London, 1858, p. 2, pl. 131.

[= *Sphyrapicus thyroideus thyroideus* (Cassin).]

Type, in British Museum: An adult male; fairly well-made skin, apparently never mounted; about 3 mm. of lower mandible missing; "Ex. coll. Cuming | ex Bridges coll." and "Trinity Valley on pines" are phrases on [newly written] labels; that is, collected by Thomas Bridges, probably in 1856 or 1857, and purchased from Hugh Cuming who apparently had gotten it from Bridges; British Mus reg. no. 58.3.1.3 [*fide* P. R. Lowe, in letter of March 18, 1930, and H. S. Swarth, MS, May 9, 1930].

Type locality, TRINITY VALLEY, Trinity County.

D[ryobates]. hyloscopus Cabanis and Heine, Mus. Heineanum, **4**, ii, 1863 (1864), p. 69 (in text of foot-note).

[= *Dryobates villosus hyloscopus* Cabanis and Heine.]

Type, male, mounted bird; received (in Berlin) through L. C. Schmidt (probably German consul in New York) in June, 1863; collector apparently Ferdinand Gruber; orig. no. 5; now no. 17575, Berlin Museum [*fide* Dr. E. Stresemann, in letter of December 12, 1921].

Type locality, SAN JOSE, Santa Clara County.

Dryobates villosus orius Oberholser, Proc. U. S. Nat. Mus., **40**, June 3, 1911, pp. 597, 609.

[= *Dryobates villosus orius* Oberholser.]

Type, male adult; skin in excellent condition; collected by Edward Garner, February 10, 1892; no. 161978, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, QUINCY, Plumas County.

Picus Turati Malherbe, Monogr. des Picidées, **1**, 1861, p. 125; **3**, 1861, pl. 29, figs. 5–7.

[= *Dryobates pubescens turati* (Malherbe).]

Type, male "jeune" [really adult, as shown by the plate]; at one time contained in Malherbe's collection at Metz; then probably passed into the possession of Count Ercole Turati, and thence into that of the Civic Museum in Milan, Italy (*fide* Palmer, Condor, **30**, 1928, p. 300).

But present location not run down by me. Who the collector could have been is as yet problematic.

Type locality, California not far from MONTEREY, Monterey County (as stated in original description).

Picus Nuttalii [*sic*] Gambel, Proc. Acad. Nat. Sci. Phila., **1**, "April" [=May 19], 1843, p. 259.

[=*Dryobates nuttallii* (Gambel).]

Type, male, probably first-year bird taken in fall or early winter; skin in fair condition; collected by William Gambel [December 10, 1841]; no. 3337, U. S. Nat. Mus. [Examined by me October 29, 1929.] On the back of the present type label is the inscription: "Rec'd by Prof. Baird from Dr. Wilson" [of the Philadelphia Academy]. The original label is in Baird's hand-writing; only "California" appears for locality.

Type locality: "This pretty species I shot in a willow thicket near the Pueblo de los Angelos [*sic*], Upper California, December 10th." Therefore about in the center of the present city of Los ANGELES, Los Angeles County.

Picus Wilsonii Malherbe, Revue et Magasin de Zoologie, ser. 2, **1**, November, 1849, p. 529.

[=*Dryobates nuttallii* (Gambel).]

Type, whereabouts not now definitely known, though possibly in the Museum of Metz (Lorraine, France) where others of Malherbe's types have been found (*fide* Dr. E. Stresemann, in letter of April 7, 1930); is said by describer to have been an adult male obtained "aux environs de Monterey, dans la Californie." Since it is named for Mr. Thomas B. Wilson, of Philadelphia, it was doubtless received from that gentleman, through whose hands are known to have passed many specimens of birds collected by William Gambel at Monterey in the early 40's.

Type locality, neighborhood of MONTEREY, Monterey County.

Leuconerpes albolarvatus Cassin, Proc. Acad. Nat. Sci. Phila., **5**, "October" [=December 7], 1850, p. 106.

[=*Xenopicus albolarvatus albolarvatus* (Cassin).]

Type, male, adult; skin in good condition, taken down from mount; plumage unworn, evidently winter-taken; shot by John G. Bell [in 1849]; no. 19338, Acad. Nat. Sci. Phila. [Examined by me October 18, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 30.)

Type locality, "Oregon canon, near GEORGETOWN, about 12 miles from Sutter's mill" [in Eldorado County] (*fide* Bell, *in* Cassin, *loc. cit.*).

Xenopicus gravirostris Grinnell, Condor, **4**, July 17, 1902, pp. 89–90.

[=*Xenopicus albolarvatus gravirostris* Grinnell.]

Type, male adult, skin in good condition; collected by J. Grinnell, July 6, 1897; orig. no. 2926, coll. J. G.; now no. 32574, Mus. Vert. Zool.

Type locality, Camp Chileo [5300 feet altitude, near Pine Flats], SAN GABRIEL MOUNTAINS, Los Angeles County.

Muscicapa semiatra Vigors, Zool. Voyage Blossom, 1839, p. 17.

[= *Sayornis nigricans semiatra* (Vigors).]

Type, not now known to exist; it is not in the British Museum (*fide* P. R. Lowe, *in litt.*, March 18, 1930).

Type locality, not stated in connection with original description; later fixed as MONTEREY, Monterey County (see Nelson, Auk, **17**, 1900, p. 125). This action is altogether reasonable because among the localities visited by the Blossom, Monterey is, all things considered, the most likely place where this species could have been collected. The Blossom was there twice, and during the second visit is the probable time of its capture, doubtless by surgeon Alexander Collie, that is, October 29 to November 17, 1827.

Tyrannula hammondii Xantus, Proc. Acad. Nat. Sci. Phila., May, 1858, p. 117.

[= *Empidonax hammondii* (Xantus).]

Type, male adult; good skin showing full fresh fall plumage; collected by John Xantus in October [of 1857]; orig. no. 803; now no. 10079, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, "vicinity of" FORT TEJON, Kern County.

Empidonax difficilis Baird, Pac. R. R. Repts., **9**, 1858, p. 198 (in text); see also pl. 76, fig. 2, of Baird's Birds N. Am., 1860, and p. VI of same work, which indicates that this plate was based on a bird from California.

[=*Empidonax difficilis difficilis* Baird.]

Type, none indicated originally; but the following specimen is now considered the type: male adult; skin in good condition save for dried blood clot on lower back; no date on label, but plumage indicates early summer as likeliest season of capture; collected by John Xantus, probably in 1857; orig. no. 1680; now no. 13720, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, FORT TEJON, Kern County.

Empidonax insulicola Oberholser, Auk, **14**, July, 1897, p. 300.

[= *Empidonax difficilis difficilis* Baird.]

Type, male in worn and somewhat faded breeding plumage; skin in fair condition; collected by Clark P. Streator, July 3, 1892; now no. 140078, U. S. Nat. Mus. (Biol. Surv. coll.). [Examined by me, last, October 30, 1929.]

Type locality, SANTA ROSA ISLAND, Santa Barbara County.

Nuttallornis borealis majorinus Bangs and Penard, Proc. Biol. Soc. Wash., **34**, June 30, 1921, pp. 90–91.

[= *Nuttallornis mesoleucus majorinus* Bangs and Penard.]

Type, male adult; skin in fair condition (molt in progress); collected by Charles H. Richardson, Jr., July 19, 1905; orig. no. 687, C. H. R., Jr.; now no. 55371, Mus. Comp. Zool. [Examined by me February 3, 1922.]

Type locality, Pine Flats [5700 feet altitude], [head of] north fork of San Gabriel River, SAN GABRIEL MOUNTAINS, Los Angeles County.

Otocoris alpestris sierrae Oberholser, Condor, **22**, January 26, 1920, p. 34.

[= *Otocoris alpestris merrilli* Dwight.]

Type, male adult, in worn breeding plumage; skin in good condition; collected by A. Sterling Bunnell, June 13, 1906; orig. no. 267; now no. 203534, U. S. Nat. Mus. (Biol. Surv. coll.). [Examined by me, last, October 30, 1929.]

Type locality, head of PINE CREEK [probably near present Bogard Ranger Station, some 25 miles east-northeast of Lassen Peak], Lassen County.

Note.—I do not consider the name *sierrae* to apply to a separately recognizable subspecies. (For my reasons, see Grinnell, Dixon and Linsdale, Univ. Calif. Publ. Zool., **35**, 1930, p. 286.)

Otocorys alpestris rubeus Henshaw, Auk, **1**, July, 1884, pp. 260, 267.

[= *Otocoris alpestris rubea* Henshaw.]

Type, male adult, in somewhat worn early breeding condition of plumage; skin in fair condition; collected by Lyman Belding [no date, but "entered" at National Museum, December 30, 1878]; no. 76599, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, certainly not "Stockton," as according to original description and most subsequent literature. The National Museum label on the type specimen bears "Stockton (?) Cal."; but all the hand-writing on it is Ridgway's, not Belding's, so the skin when received may have lacked a label, and Belding's home town was inferred to be the locality of its capture. Mistakes of this sort frequently occurred in the handling of Belding's collections at the National Museum (*teste* L. Belding, MS, November 15, 1905). Furthermore, the type bird, no. 76599, is definitely listed (Belding, Proc. U. S. Nat Mus., **1**, 1879, p. 423) as taken in February, 1878, at Marysville, not Stockton. Also, the race *rubea* has not, to my knowledge, been authentically recorded from so far south as Stockton.

Judging from the above circumstances and from the characters of the type and the limits of the determined range of the quite sedentary race *rubea*, its type locality may now definitely be designated as MARYSVILLE, Yuba County; more exactly, "the low rolling hills on the eastern margin of the [Sacramento] valley [near there], where the growth of vegetation is meager" (Belding, *loc. cit.*).

Otocoris berlepschi Hartert, Journ. f. Orn., **38**, 1890, p. 103. [See also Hartert, Ibis, ser. 6, **4**, 1892, p. 522, pl. 13.]

[=, probably, *Otocoris alpestris rubea* Henshaw.]

Type, a mounted bird in the Senckenberg Museum, Frankfurt, Germany. No more information as to its history than the ostensible general locality given on a label has been forthcoming.

Type locality, "Caffraria"; but no evidence otherwise supports the original supposition that the type, still unique as to chief character (extension of black on the head), really came from South Africa. Rather does it now appear likely that it came from California (the spelling in hand-writing could easily be so confused); and careful

comparison by Dr. Oscar Neumann (Journ. f. Orn., **75**, 1927, pp. 374ff) indicates it most likely to be a color variant or "mutant" in the Sacramento Valley race of horned lark. Indeed, in the same museum, Neumann tells us, is a specimen of *rubea* (resembling the type except as to the aberrancy) taken by "J" [=F]. Gruber at Williams Station, California, "3. 2. 1863." There is thus a good chance that the type of *O. berlepschi* came from the same source. Hence the type locality for the latter name may now be given, tentatively, as WILLIAMS, Colusa County.

Otocoris alpestris actia Oberholser, Proc. U. S. Nat. Mus., **24**, June 9, 1902, p. 845.

[= *Otocoris alpestris actia* Oberholser.]

Type, male adult, in somewhat worn breeding stage of plumage; skin in excellent condition; collected by Edgar A. Mearns, May 23, 1894; orig. no. 10920; now no. 133678, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, JACUMBA, San Diego County.

Alauda rufa Audubon, Birds Am., **7**, 1844, p. 353, pl. 497.

[= *Otocoris alpestris actia* Oberholser.]

Type: The bird supposed to be the type, but without any original or collector's label, is: no. 2893, U. S. National Museum; skin in fairly good condition, not appreciably faded; obviously a breeding male (though sex not recorded); judging from stage of wear, especially on head and wings, taken in March or April. [Forwarded and examined by me November 29, 1930.] The oldest, Baird-collection label bears only: Otocoris rufus ? | 2893. In subspecific characters (color tones and measurements) this bird is a facsimile of specimens collected in recent years in Los Angeles County.

Type locality, none given (aside from "Western States") in connection with original description, nor indicated anywhere else insofar as I know. The type, as stated by Oberholser (Proc. U. S. Nat. Mus., **24**, 1902, p. 848), with which Audubon's description and plate agree, belongs to the race *actia*, with, in my own mind, no doubt whatsoever. Hence it must have been taken within the range of that race, and therefore in west-central or southern California. All things considered, it could well have been taken by Gambel, who entered California in 1841, and in the vicinity of LOS ANGELES, which is here suggested as a type locality. Baird is known to have come into the possession of a number of birds collected by Gambel, and the above type came into the National collection from Baird.

Audubon's name *rufa* would be usable in place of the later name *actia*, if it were not preoccupied (*fide* Oberholser, *loc. cit.*).

Otocoris alpestris insularis C. H. Townsend, Proc. U. S. Nat. Mus., **13**, September 9, 1890, p. 140.

[= *Otocoris alpestris insularis* C. H. Townsend.]

Type, male adult; good skin, in slightly worn full mid-winter plumage; collected by Charles H. Townsend, January 25, 1889; no. 117674, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County.

Otocoris alpestris ammophila Oberholser, Proc. U. S. Nat. Mus., **24**, June 9, 1902, p. 849.

[= *Otocoris alpestris ammophila* Oberholser.]

Type, male adult; skin in good condition (in worn breeding plumage); collected by Theodore S. Palmer, May 11, 1891; now no. 139892, U. S. Nat. Mus. (Biol. Surv. coll.). [Examined by me, last, October 30, 1929.]

Type locality, near Maturango Spring, Coso VALLEY, Inyo County.

Tachycineta lepida Mearns, Proc. Biol. Soc. Wash., **15**, March 5, 1902, pp. 31–32.

[= *Tachycineta thalassina lepida* Mearns.]

Type, male adult; skin in excellent condition; collected by Edgar A. Mearns, June 9, 1894; orig. no. 11014; now no. 133522, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, Campbell's ranch, LAGUNA MOUNTAINS, twenty miles north of Campo, San Diego County; altitude near 5500 feet (see Mearns, U. S. Nat. Mus. Bull., **56**, 1907, p. 135).

Hirundo bicolor var. **vespertina** Cooper, Am. Naturalist, **10**, February, 1876, p. 91.

[= *Iridoprocne bicolor* (Vieillot).]

Type, none designated; there may, indeed, have been no specimen in hand when the brief and rather general diagnosis was written: "larger and bluer than the eastern" variety.

Type locality: Reference is made definitely to a nesting pair of "white-bellied swallows" [in May, 1875] near the house in Dr. James G. Cooper's "garden at Haywood [*sic*], eighteen miles southeast of San Francisco . . .". Therefore, HAYWARD, Alameda County.

Cyanocitta stelleri carbonacea Grinnell, Condor, **2**, November 16, 1900, p. 127.

[= *Cyanocitta stelleri carbonacea* Grinnell.]

Type, female, probably in first annual plumage; skin in good condition; collected by J. Grinnell, October 13, 1900; orig. no. 4419; now no. 33713, Mus. Vert. Zool.

Type locality, STEVENS CREEK CAÑON [near Monte Bello Ridge, some 15 miles south-southeast of Palo Alto], Santa Clara County.

Aphelocoma californica oocleptica Swarth, Univ. Calif. Publ. Zool., **17**, February 23, 1918, pp. 413–414.

[= *Aphelocoma californica oocleptica* Swarth.]

Type, male, probably in first annual plumage; skin in good condition; collected by Walter P. Taylor, February 23, 1909; orig. no 647; now no. 7123, Mus. Vert. Zool.

Type locality, [near neighborhood of old village of] NICASIO, Marin County.

Garrulus Californicus Vigors, Zool. Voyage Blossom, 1839, p. 21, pl. 5.

[= *Aphelocoma californica californica* (Vigors).]

Type, not known now to be in existence, insofar as I can find out. Not in the British Museum (*fide* P. R. Lowe, *in litt.*, March 18, 1930).

Type locality: "It was found in abundance at Monterey" (Vigors, *loc. cit.*). This was during the visits of the Blossom at that place, January 1 to 5, 1827, and October 29 to November 17, 1827. The observer, and collector of the specimen or specimens taken, was doubtless surgeon Alexander Collie. Therefore MONTEREY, Monterey County.

Aphelocoma insularis Henshaw, Auk, **3**, October, 1886, p. 452.

[= *Aphelocoma insularis* Henshaw.]

Type, [male ?] adult; skin in good condition; collected by Henry W. Henshaw, June 2, 1875; orig. no. 733; now no. 79695, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, SANTA CRUZ ISLAND, Santa Barbara County.

Corvus nutallii [*sic*] Audubon, Birds Am. (folio), **4**, 1836 (or 1837), pl. 362, fig. 1.

[=*Pica nuttallii* (Audubon).]

Type, skin in good condition; [sex not recorded, probably male, as judged from wing-length, which is 193 mm.]; collected by Thomas Nuttall [in April, 1836]; oldest label now on specimen is in S. F. Baird's hand-writing; no. 2845, U. S. Nat. Mus.; "received [by Baird] from Audubon." [Examined by me October 30, 1929.]

Type locality, "the vicinity of SANTA BARBARA" [Santa Barbara County] (Nuttall, Manual Orn., ed. 2, 1840, p. 236).

Penthestes gambeli abbreviatus Grinnell, Univ. Calif. Publ. Zool., **17**, May 4, 1918, p. 510.

[= *Penthestes gambeli abbreviatus* Grinnell.]

Type, male; skin in good condition; collected by Malcolm P. Anderson, December 12, 1901; orig. no. 119, coll. M. P. Anderson, for some years in Grinnell coll.; now no. 38709, Mus. Vert. Zool.

Type locality, Horse Creek, near [7 miles northeast of] SEIAD P. O., [on south slope of] Siskiyou Mountains, Siskiyou County.

Parus gambeli baileyæ Grinnell, Condor, **10**, January [published February 1], 1908, p. 29.

[= *Penthestes gambeli baileyae* (Grinnell).]

Type, male adult; skin in good condition; collected by J. Grinnell, November 27, 1903; orig. no. 5516, coll. J. G.; now no. 38731, Mus. Vert. Zool.

Type locality, MOUNT WILSON at 5500 feet altitude, San Gabriel Mountains, near Pasadena, Los Angeles County.

Penthestes gambeli inyoensis Grinnell, Univ. Calif. Publ. Zool., **17**, May 4, 1918, p. 509.

[= *Penthestes gambeli inyoensis* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, October 7, 1917; orig. no. 4588, J. G., new field series; now no. 28782, Mus. Vert. Zool.

Type locality, three miles east of JACKASS SPRING at 6200 feet altitude, Panamint Mountains (northern part), Inyo County.

Parus rufescens, β. neglectus Ridgway, Proc. U. S. Nat. Mus., **1**, May 22, 1879, p. 485.

[=*Penthestes rufescens neglectus* (Ridgway).]

Type, male adult; skin in excellent condition; collected by Charles A. Allen, February 1, 1877; formerly in private collection of Robert Ridgway; now no. 82671, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, "Coast of California"; later, by Ridgway's own indication of a type, as above, fixed as [at or near] NICASIO, Marin County.

Parus rufescens barlowi Grinnell, Condor, **2**, November 16, 1900, p. 127.

[=*Penthestes rufescens barlowi* (Grinnell).]

Type, male adult; skin in good condition; collected by J. Grinnell, October 13, 1900; orig. no. 4425, coll. J. G.; now no. 38858, Mus. Vert. Zool.

Type locality, STEVENS CREEK CAÑON [near Monte Bello Ridge, some 15 miles south-southeast of Palo Alto], Santa Clara County.

Parus inornatus Gambel, Proc. Acad. Nat. Sci. Phila., **2**, "August" [=December 5], 1845, p. 265.

[=*Baeolophus inornatus inornatus* (Gambel).]

Type, [sex ?], skin in good condition, little, if any, faded; apparently in first annual plumage, unworn and hence autumn-taken; collected by William Gambel [probably on November 20, 1842]; now no. 3340, U. S. Nat. Mus.; once in Acad. Nat. Sci. Phila.; a comment on one of the labels reads: "Received by Baird from Dr. Wilson on (or before) 1847." (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 20.) [Type examined by me October 27, 1929.]

Type locality, MONTEREY [Monterey County]; definitely so stated by Gambel himself (Proc. Acad. Nat. Sci. Phila., **3**, 1847, p. 154).

Bæolophus inornatus restrictus Ridgway, Proc. Biol. Soc. Wash., **16**, September 30, 1903, p. 190.

[=*Baeolophus inornatus inornatus* (Gambel).]

Type, male, in full first annual plumage; skin in fair condition, somewhat discolored by smoke (see Grinnell, Auk, **23**, 1906, pp. 186–188); collected by Dr. John Hornung, March 24, 1896; no. 163569, U. S. Nat. Mus. [Examined by me, last, on October 27, 1929.]

Type locality, OAKLAND [probably in the Piedmont district], Alameda County.

Baeolophus inornatus transpositus Grinnell, Condor, **30**, March 15, 1928, p. 154.

[=*Baeolophus inornatus transpositus* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, December 12, 1896; orig. no. 1828, coll. J. G.; now no. 38685, Mus. Vert. Zool.

Type locality, [at about 5500 feet altitude near the old "Martin's Camp" on] MOUNT WILSON ["Wilson's Peak"], near Pasadena, Los Angeles County.

Auriparus flaviceps acaciarum Grinnell, Condor, **33**, July 18, 1931, p. 168.

[= *Auriparus flaviceps acaciarum* Grinnell.]

Type, male adult; skin in good condition; collected by Joseph Grinnell, January 2, 1904; orig. no. 5616, coll. J. G.; now no. 38962, Mus. Vert. Zool.

Type locality, PALM SPRINGS, 450 feet altitude, Riverside County.

Psaltriparus minimus californicus Ridgway, Proc. Biol. Soc. Wash., **2**, April 10, 1884, pp. 89–90.

[= *Psaltriparus minimus californicus* Ridgway.]

Type [the first one in order of sequence, of five "types" designated in connection with the original description], male, skin in fair condition; in first annual plumage; collected by Charles H. Townsend, May 27 [or 29], 1883; orig. no. 96; now no. 91643, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, BAIRD, Shasta County.

Sitta aculeata Cassin, Proc. Acad. Nat. Sci. Phila., **8**, "October, 1856" [= April 25, 1857], p. 254.

[= *Sitta carolinensis aculeata* Cassin.]

Type, male, in first-winter plumage; skin in fair condition, taken down from mount; on type label: "♂ California Dr. Gambel"; no. 23684, in coll. Academy of Natural Sciences of Philadelphia. (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 31.) [Examined by me October 19, 1929.]

Type locality, "California." The type looks to me most like birds from west-central California; the bill is small, identical with specimens compared with it; culmen 17.4, wing 84.4 mm. I therefore hereby restrict the type locality to MONTEREY, Monterey County, because Gambel was known to have been there, in "November" [1842 ?], and to have encountered "*Sitta carolinensis*" in the "wooded regions of the western coast." (See Gambel, Proc. Acad. Nat. Sci. Phila., **3**, 1846, p. 112, and 1847, p. 154.)

Sitta carolinensis tenuissima Grinnell, Condor, **20**, March 20, 1918, p. 88.

[= *Sitta carolinensis tenuissima* Grinnell.]

Type, male adult, in moderately worn "breeding" plumage; skin in good condition; collected by Joseph Dixon, June 1, 1917; orig. no. 6114; now no. 28716, Mus. Vert. Zool.

Type locality, HANAUPAH CANYON at 8700 feet altitude, east side of Panamint Mountains, Inyo County.

Sitta pygmæa Vigors, Zool. Voyage Blossom, 1839, p. 25, pl. 4, fig. 2.

[= *Sitta pygmaea pygmaea* Vigors.]

Type, perhaps once in the British Museum; apparently not now to be found there and fate unknown (*fide* P. R. Lowe, *in litt.,* March 18, 1930). Taken with very little doubt by surgeon Alexander Collie, and probably during the Blossom's second visit at Monterey, October 29 to November 17, 1827.

Type locality: Vigors' statement is definite: "One specimen was brought from MONTEREY" [Monterey County].

Certhia familiaris zelotes Osgood, Auk, **18**, April, 1901, p. 182.
[= *Certhia familiaris zelotes* Osgood.]
Type, female adult, in full annual plumage; skin in good condition; collected by Richard C. McGregor, October 23, 1898; no. 170708, U. S. Nat. Mus. [Examined by me October 27, 1929.]
Type locality, BATTLE CREEK [probably within five miles of Sacramento River and in near vicinity of the U. S. fish hatchery], near Ball's Ferry, Shasta County.

Chamaea fasciata rufula Ridgway, Proc. Biol. Soc. Wash., **16**, September 30, 1903, p. 109.
[= *Chamaea fasciata rufula* Ridgway.]
Type, male, in first full annual plumage; skin in excellent condition; collected by Charles A. Allen, December 8, 1876; formerly in private collection of Robert Ridgway; now no. 82620, U. S. Nat. Mus. [Examined by me October 27, 1929.]
Type locality, [at or near] NICASIO, Marin County.

Parus fasciatus Gambel, Proc. Acad Nat. Sci. Phila., **2**, "August" [= December 5], 1845, p. 265.
[= *Chamaea fasciata fasciata* (Gambel).]
Type, collected by William Gambel, probably about 1842; date, sex, and exact locality wanting; apparently the only wren-tit collected by Gambel now in existence; skin in fair condition, but obviously somewhat yellowed by age; now no. 3339, U. S. National Mus. [Examined by me on several occasions, last, October 27, 1929.]
Type locality, "California." The type most nearly resembles skins of the wren-tit from Monterey and vicinity (comparisons made by me); and Gambel is known to have collected other birds at that place. Therefore MONTEREY, Monterey County, can properly be designated as the type locality of *Parus fasciatus* (see also Grinnell and Swarth, Univ. Calif. Publ. Zool., **30**, 1926, p. 172). This does not conflict vitally with the previously expressed views of Ridgway (U. S. Nat. Mus. Bull., **50**, pt. 3, 1904, p. 687, footnote).

Chamæa fasciata intermedia Grinnell. Condor, **2**, July 14, 1900, p. 86.
[= *Chamaea fasciata fasciata* (Gambel).]
Type, male adult, in somewhat worn "breeding" plumage; skin in good condition; collected by J. Grinnell, May 28, 1900; orig. no. 4211, coll. J. G.; now no. 38979, Mus. Vert. Zool.
Type locality, [willow patch at mouth of San Francisquito Creek near] PALO ALTO, Santa Clara County.

Chamæa fasciata henshawi Ridgway, Proc. U. S. Nat. Mus., **5**, June 14, 1882, pp. 13–14.
[= *Chamaea fasciata henshawi* Ridgway.]
Type, female, seemingly in first, full annual plumage; skin in good condition; collected by Henry W. Henshaw, November 11, 1875; orig. no. 705; now no. 71986, U. S. Nat. Mus. [Examined by me October 27, 1929.]
Type locality, "Walker's Basin" [= WALKER BASIN, northeast of Caliente, Kern County].

Thryomanes bewicki marinensis Grinnell, Univ. Calif. Publ. Zool., 5, February 21, 1910, p. 307.

[= *Thryomanes bewickii marinensis* Grinnell.]

Type, male adult; skin in fair condition; collected by Annie M. Alexander, February 21, 1909; now no. 7243, Mus. Vert. Zool.

Type locality, [a "redwood cañon" in near neighborhood of the old village of] Nicasio, Marin County.

Troglodytes spilurus Vigors, Zool. Voyage Blossom, 1839, p. 18, pl. 4, fig. 1.

[= *Thryomanes bewickii spilurus* (Vigors).]

Type, might have been once in the British Museum; not known now to be there or anywhere else (*fide* P. R. Lowe, *in litt.*, March 18, 1930). Collected doubtless by surgeon Alexander Collie, in 1826 or 1827.

Type locality, not stated in connection with the original description. It must have been either San Francisco or Monterey, as these were the only two localities on the coast of the United States at which the Blossom stopped. Oberholser (Wilson Bull., **32**, 1920, p. 24) has "definitely fixed" San Francisco, San Francisco County, as the type locality. The Blossom was anchored in San Francisco Bay on two visits, November 7 to December 28, 1826, and November 19 to December 3, 1827.

Thryomanes bewickii drymœcus Oberholser, Proc. U. S. Nat. Mus., **21**, November 19, 1898, p. 437.

[= *Thryomanes bewickii drymoecus* Oberholser.]

Type, male adult; good skin, in somewhat worn breeding condition of plumage; collected by Charles H. Townsend, June 6, 1883; orig. no. 116; now no. 91640 [not "91610"], U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, Baird, Shasta County.

Thryomanes bewickii correctus Grinnell, Condor, **30**, March 15, 1928, pp. 154–155.

[= *Thryomanes bewickii correctus* Grinnell.]

Type, male, in first annual plumage; skin in good condition; collected by J. Grinnell, September 17, 1897; orig. no. 3149, coll. J. G.; now no. 38287, Mus. Vert. Zool.

Type locality, [Arroyo Seco, just above Devil's Gate, near] Pasadena, Los Angeles County.

Thryomanes bewickii nesophilus Oberholser, Proc. U. S. Nat. Mus., **21**, November 19, 1898, p. 442.

[= *Thryomanes bewickii nesophilus* Oberholser.]

Type, male adult; skin in good condition; collected by Charles H. Townsend, February 7, 1889; no. 117641, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, Santa Cruz Island, Santa Barbara County.

Thryomanes bewicki catalinae Grinnell, Univ. Calif. Publ. Zool., **5**, February 21, 1910, p. 308.

[= *Thryomanes bewickii catalinae* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, December 24, 1897; orig. no. 3277, coll. J. G.; now no. 38239, Mus. Vert. Zool.

Type locality, [brushy hills immediately back of] Avalon, SANTA CATALINA ISLAND, Los Angeles County.

Thryothorus leucophrys Anthony, Auk, **12**, January, 1895, p. 52.

[= *Thryomanes bewickii leucophrys* (Anthony).]

Type, male, in complete, unworn, annual plumage; skin in excellent condition; collected by Alfred W. Anthony, August 27, 1894; orig. no. 5514, coll. A. W. A.; now no. 17915, Carnegie Museum . [Forwarded and examined by me, May 7, 1930.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County; more exactly, Smugglers [now Pyramid] Cove (see Mearns, U. S. Nat. Mus. Bull., **56**, 1907, p. 139).

Telmatodytes palustris æstuarinus Swarth, Auk, **34**, July [published June 30], 1917, p. 310.

[= *Telmatodytes palustris aestuarinus* Swarth.]

Type, male adult; skin in good condition; collected by J. Grinnell, April 17, 1915; orig. no. 3152, J. G., new field series; now no. 25349, Mus. Vert. Zool.

Type locality, [the Innisfail Farm, on] GRIZZLY ISLAND, near Suisun Bay, Solano County.

Catherpes mexicanus punctulatus Ridgway, Proc. U. S. Nat. Mus., **5**, September 11, 1882, p. 343.

[= *Catherpes mexicanus punctulatus* Ridgway.]

Type, male, adult; skin in good condition; collected by [or for] Ferdinand Gruber, October 7, 1862; orig. no. apparently 902; for a time in Robert Ridgway's private collection ("presented by Dr. E. Coues"); now no. 82715, U. S. Nat. Mus. [Examined by me October 30, 1929.] A female "type" was also designated in the original description—from another locality. While both were at the outset equivalently cotypes, the first mentioned was subsequently designated as *the* type (see Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 3, 1904, p. 660).

Type locality, FOREST HILL, Placer County.

Salpinctes obsoletus pulverius Grinnell, Auk, **15**, July, 1898, p. 238.

[= *Salpinctes obsoletus obsoletus* (Say).]

Type, male adult; skin in good condition, but in very much worn and faded state of plumage; collected by J. Grinnell, May 19, 1897; orig. no. 2615; now no. 162710, U. S. Nat. Mus. [Re-examined by me October 30, 1929.]

Type locality, SAN NICOLAS ISLAND, Ventura County.

Orpheus leucopterus Vigors, Zool. Voyage Blossom, 1839, p. 17. [= *Mimus polyglottos leucopterus* (Vigors).]

Type: The original description was based on "three or four specimens" but with "no note . . . attached to any, to indicate their locality" (Vigors, *op. cit.*, p. 18). No specimen considered the type is now in the British Museum (*fide* P. R. Lowe, *in litt.*, March 18, 1930).

Type locality, no indication given in connection with original description; must have been one of the places at which the Blossom stopped, on the west coast of North America (see Mearns, Auk, **19**, 1902, p. 71). Of these, all things considered, MONTEREY, Monterey County, is the most likely and is hereby chosen and fixed. Collections of birds were made here by surgeon Alexander Collie; and the period of the second visit of the Blossom at Monterey is most likely the time, namely, October 29 to November 17, 1827.

Mimus canadatus [typographical error for **caudatus**] Baird, Pac. R. R. Repts., **9**, 1858, pp. 345 (in text), "xxxxv" [= xxxv], 987.

[= *Mimus polyglottos leucopterus* (Vigors).]

Type, male [probably first-year]; skin in good condition, in complete unworn, hence autumn, plumage; collected by Dr. A. L. Heermann, in [probably November] 1853; now no. 8159, U. S. Nat. Mus. [Examined by me October 30, 1929.]

Type locality, "Los Angeles valley"; probably well within the territory now covered by the city of LOS ANGELES, Los Angeles County.

Toxostoma redivivum sonomae Grinnell, Pacific Coast Avifauna, No. 11, October 21, 1915, p. 155.

[= *Toxostoma redivivum sonomae* Grinnell.]

Type, male adult, in annual molt which is approaching completion; skin in good condition; collected by Joseph and Hilda Wood Grinnell, August 30, 1913; orig. no. 2323, coll. J. Grinnell, new field series; now no. 23615, Mus. Vert. Zool.

Type locality, among hills one mile west of GUERNEVILLE, Sonoma County.

Harpes rediviva Gambel, Proc. Acad. Nat. Sci. Phila., **2**, "August" [= December 5], 1845, p. 264.

[= *Toxostoma redivivum redivivum* (Gambel).]

Type, [sex ?], skin in fairly good condition, unworn and apparently but little faded, taken down from mount; seemingly in first-winter plumage; collected by William Gambel, probably in autumn of 1842; no. 23715, Acad. Nat. Sci. Phila. (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 20.) [Examined by me October 18, 1929.]

Type locality, MONTEREY, Monterey County; so stated by Gambel himself (Journ. Acad. Nat. Sci. Phila., **1**, 1847, p. 43).

Harporhynchus redivivus pasadenensis Grinnell, Auk, **15**, July, 1898, p. 237.

[= *Toxostoma redivivum redivivum* (Gambel).]

Type, male adult; skin in good condition; collected by Joseph Grinnell, February 6, 1897; orig. no. 2056; now no. 163068, U. S. Nat. Mus. [Re-examined by me, October 30, 1929.]

Type locality, PASADENA [more exactly, Eaton Cañon "wash", some 3 miles southeast of Altadena], Los Angeles County.

Toxostoma Le Contei Lawrence, Ann. Lyc. Nat. Hist. N. Y., **5**, 1852 ["Sept., 1851"], p. 121.

[= *Toxostoma lecontei lecontei* Lawrence.]

Type, adult [female, to judge from measurements]; skin, poorly made and now rather soiled and yellowed with age; in full, unabraded annual plumage (hence taken in autumn or early winter); "obtained . . . by John L. Le Conte, M. D."; formerly in coll. Geo. N. Lawrence; now no. 39247, American Museum of Natural History, New York City (forwarded and examined by me May 3, 1930). Of the three labels now borne by this specimen, the oldest is the Lawrence collection label which gives, on one side, "Presented by J. L. Leconte Type Gila River"; on the other, "Harporhynchus lecontii Lawr | California—Fort Yuma [apparently this word written in later] 257 [this being merely the old Baird Catalogue number]." Le Conte says (Ann. Lyc. Nat. Hist. N. Y., **5**, 1852, p. 125) that he collected [beetles] "during the year 1850 and part of 1851" . . . at . . . "Vallecitas and the Desert of the Colorado, in October and November; Colorado River, December and March; Valley of the Gila, in January and February." Also he refers to the military post at "the Colorado" which, of course, is old Fort (or Camp) Yuma, on the California side, first established early in 1850. The type was thus probably taken in December, 1850.

Type locality, "California, near the junction of the Gila and Colorado Rivers" (Lawrence, *loc. cit.*). Later stated (Baird, Pac. R. R. Repts., **9**, 1858, p. 350, and elsewhere) to have been "Fort Yuma." Hence: vicinity of old FORT YUMA, Imperial County.

Hylocichla aonalaschkæ slevini Grinnell, Auk, **18**, July, 1901, pp. 258–259.

[= *Hylocichla guttata slevini* Grinnell.]

Type, male adult; skin, collected by Thomas E. Slevin, May 9, 1898; no. 14096, in old collection of California Academy of Sciences; doubtless destroyed in the San Francisco fire of 1906.

Type locality, vicinity of POINT SUR, on coast of Monterey County.

Turdus sequoiensis Belding, Proc. Calif. Acad. Sci., ser. 2, **2**, June 11, 1889, p. 18.

[= *Hylocichla guttata sequoiensis* (Belding).]

Type, male, "in best breeding plumage"; skin, collected by Lyman Belding, May 26, 1889; "no. 326"; in old collection of California Academy of Sciences; a female "type" also designated; both specimens doubtless destroyed in the San Francisco fire of 1906.

Type locality, BIG TREES, Calaveras County.

Hylocichla guttata polionota Grinnell, Condor, **20**, March 20, 1918, p. 89.

[= *Hylocichla guttata polionota* Grinnell.]

Type, male, in molt from juvenal to first annual plumage; skin in good condition; collected by Halsted G. White, August 18, 1917; orig. no. 1305; now no. 28848, Mus. Vert. Zool.

Type locality, Wyman Creek at 8000 feet altitude, east slope of WHITE MOUNTAINS, Inyo County.

Hylocichla ustulata œdica Oberholser, Auk, **16**, January, 1899, pp. 23–24.

[=*Hylocichla ustulata ustulata* (Nuttall).]

Type, male adult; plumage worn and somewhat faded; skin in fairly good condition; collected by Henry W. Henshaw, June 25, 1875; orig. no. 66; now no. 79462, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, SANTA BARBARA, Santa Barbara County.

Sialia cæruleocollis Vigors, Zool. Voyage Blossom, 1839, p. 18, pl. 3.

[=*Sialia mexicana occidentalis* J. K. Townsend.]

Type, not known to be extant. It did not come to the British Museum at the time of the dispersal of the Zoological Society's collection (P. R. Lowe, in letter of November 22, 1930).

Type locality: no locality given in connection with original description. But the type specimen (figured) and another (evidently female) mentioned, doubtless obtained, by surgeon Alexander Collie, at either San Francisco or Monterey—all things considered, most likely at MONTEREY, Monterey County (therefore here so fixed). The Blossom was at Monterey twice, and the period of the second visit, October 29 to November 17, 1827, is that when probably most of Collie's collecting was done.

Polioptila caerulea amoenissima Grinnell, Proc. Calif. Acad. Sci., ser. 4, **15**, September 15, 1926, p. 494.

[=*Polioptila caerulea amoenissima* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, May 23, 1915; orig. no. 3173, J. G., new field series; now no. 25813, Mus. Vert. Zool.

Type locality, PLEASANT VALLEY, 600 feet altitude, Mariposa County.

Polioptila californica Brewster, Bull. Nuttall Orn. Club, **6**, April, 1881, p. 103.

[=*Polioptila melanura californica* Brewster.]

Type, male adult; skin in fair condition; collected by Frank Stephens, March 28, 1878; once no. 1489, coll. William Brewster; now no. 201489, Mus. Comparative Zoology. [Examined by me October 15, 1930.]

Type locality, "Riverside, San Bernardino County"; that is, now, RIVERSIDE, Riverside County.

Regulus calendula cineraceus Grinnell, Condor, **6**, January 15, 1904, p. 25.

[=*Corthylio calendula cineraceus* (Grinnell).]

Type, male adult, in rather worn plumage; skin in fair condition; collected by J. Grinnell, May 9, 1896; orig. no. 1039, coll. J. G.; now no. 39161, Mus. Vert. Zool.

Type locality, Strain's Camp, [at 5250 feet altitude on north side of] MOUNT WILSON, San Gabriel Mountains, near Pasadena, Los Angeles County.

Phainopepla nitens lepida Van Tyne, Occasional Papers Boston Soc. Nat. Hist., **5**, May 22, 1925, p. 149.

[=*Phainopepla nitens lepida* Van Tyne.]

Type, male adult; skin in good condition; collected by Frank Stephens, May 14, 1878; once no. 653, coll. William Brewster; now no. 200653, Mus. Comparative Zool. [Examined last by me, October 15, 1930.]

Type locality, RIVERSIDE, Riverside County.

L[anius]. ludovicianus gambeli Ridgway, Manual N. Am. Birds, 1887 [later than October 20], p. 467.

[=*Lanius ludovicianus gambeli* Ridgway.]

Type, [not sexed]; skin in good condition; collected by Lyman Belding, in December, 1877; Calaveras County; now no. 80468, U. S. Nat. Mus. [Examined, last, by me October 30, 1929.] This specimen selected as the type probably by Robert Ridgway, himself, in the early '80's.

Type locality: "California, especially coast district", only indication in connection with original description (cited above). Later restricted to "Calaveras County" (A. O. U. Check-list, ed. 3, 1910, p. 297). There was probably just one shrike collected by Belding in Calaveras County in December, 1877, and this earlier one was listed (Belding, Proc. U. S. Nat. Mus., **1**, 1879, p. 411, in lowermost table) as definitely from "Murphy's". The number there given is, however, "73971"; and an entry in the National Museum register opposite that number says "destroyed Aug. 1881." Yet the now supposed type specimen bears exactly the same data. Possibly the specimen was re-catalogued, or else labels transposed. Despite this confusion as to type specimen, it is clear that the exact type locality is MURPHY, 2200 feet altitude, 6 miles northeast of Angels, Calaveras County.

Lanius ludovicianus nevadensis A. H. Miller, Condor, **32**, May 15, 1930, p. 156.

[=*Lanius ludovicianus nevadensis* A. H. Miller.]

Type, female adult; plumage moderately worn; skin in good condition; collected by Harry S. Swarth, April 11, 1912; orig. no. 9406, H. S. S.; now no. 22625, Mus. Vert. Zool.

Type locality, Lone Pine Creek, 4500 feet altitude, near LONE PINE, Inyo County.

Lanius ludovicianus anthonyi Mearns, Auk, **15**, July, 1898, p. 261.

[=*Lanius ludovicianus anthonyi* Mearns.]

Type, female [about one year old]; skin in good condition; collected by Rollo H. Beck, May 6, 1897; orig. no. 131; now no. 163074, U. S. Nat. Mus. [Examined by me, last, October 30, 1929.]

Type locality, SANTA CRUZ ISLAND, Santa Barbara County; the western end of this island (see Beck, Bull. Cooper Orn. Club, **1**, 1899, p. 6).

Lanius ludovicianus mearnsi Ridgway, Proc. Biol. Soc. Wash., **16**, September 30, 1903, p. 108.

[=*Lanius ludovicianus mearnsi* Ridgway.]

Type, female [not "adult", but immature, much juvenal body-plumage persisting]; skin in good condition; collected by Edgar A.

Mearns, August 27, 1894; orig. no. 11368; now no. 134781, U. S. Nat. Mus. [Examined by me, last, October 30, 1929.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County; more exactly, Smugglers [now Pyramid] Cove, southeast end of that island (see Mearns, U. S. Nat. Mus. Bull., **56**, 1907, p. 139).

Vireo huttoni Cassin, Proc. Acad. Nat. Sci. Phila., **5**, "February" [=June 30], 1851, p. 150; *ibid.*, **6**, pl. 10, fig. 1.

[= *Vireo huttoni huttoni* Cassin.]

Type, [sex ?], good skin, in fresh, full annual plumage; collected by William Hutton; the date "June 1847" appears on the Smithsonian label, but the state of the plumage makes the month of September far more likely; no. 3725, U. S. Nat. Mus. [Examined by me October 28, 1929.] Another specimen, no. 3724, U. S. Nat. Mus., of same data, also bears a type label; but Baird, in Rev. Am. Birds, 1866, p. 357, definitely selects no. 3725 as *the* type.

Type locality, MONTEREY, Monterey County.

Vireo mailliardorum Grinnell, Condor, **5**, November 16, 1903, p. 157.

[= *Vireo huttoni huttoni* Cassin.]

Type, male adult, in unworn, annual plumage; skin in good condition; collected by J. Grinnell, September 1, 1903; orig. no. 5425, coll. J. G.; now no. 37129, Mus. Vert. Zool.

Type locality, [cañon opening into] Friar's [or Frye's] Harbor, [near northwest end of] SANTA CRUZ ISLAND, Santa Barbara County.

Vireo huttoni oberholseri Bishop, Condor, **7**, September, 1905, pp. 142–143.

[= *Vireo huttoni huttoni* Cassin.]

Type, male adult; skin in good condition; collected by Henry W. Marsden, April 9, 1904; orig. no. 1061; now no. 10891, coll. Louis B. Bishop. [Examined by me January 8, 1930; forwarded.]

Type locality, WITCH CREEK, San Diego County.

Vireo pusillus albatus Grinnell, Condor, **3**, November 16, 1901, p. 187.

[= *Vireo bellii pusillus* Coues.]

Type, male adult; skin in good condition; collected by J. Grinnell, April 25, 1896; orig. no. 961, coll. J. G.; now no. 37139, Mus. Vert. Zool.

Type locality, [Arroyo Seco, 1100 feet altitude, above Devil's Gate, near] PASADENA, Los Angeles County.

Vireo vicinior californicus Stephens, Auk, **7**, April, 1890, p. 159.

[= *Vireo vicinior* Coues.]

Type, none designated in original description; there evidently *was* a type, collected by Frank Stephens, but it has now disappeared; it is not to be found in either the United States National Museum, or in the collection of the San Diego Society of Natural History, or in that of the Museum of Comparative Zoology at Cambridge.

Under date January 3, 1930 (L. M. Huey, *in litt.*), Mr. Frank Stephens gave it verbally as his recollection that "the type and about a dozen Gray Vireos were sent to Robert Ridgway in the fall of 1889", but that "his memory regarding the allocation of the type from there is hazy"; he now "feels that it was presented to the National Museum. The other remaining specimens were lost in the mail on their return journey and never heard from, although an inquiry was made." Search now in the National Museum shows no record of any type specimen of *Vireo* ever having been received from Mr. Stephens; there is only one specimen of *V. vicinior* of his collecting there and that one was from San Diego, received in 1877 (*fide* C. W. Richmond, *in litt.*, January 21, 1930). Thus, it is practically conclusive that the type was not kept there but was returned and was lost in transit.

Type locality, not definitely indicated in original description; only one locality mentioned, "ten miles east of Riverside", Riverside County, where, it is recorded, a nest and eggs were taken April 26, 1889. Subsequently, Ridgway (U. S. Nat. Mus. Bull., **50**, pt. 3, 1904, p. 204) gave the type locality definitely as "Riverside, s. California; coll. F. Stephens." It is very probable, from the above testimony, that Ridgway had examined the actual type. The locality of capture, more exactly, was doubtless the vicinity of Box Springs near the head of Box Springs Cañon, a (then) well-known camping place on the old wagon road southeast from RIVERSIDE.

Vireo cassinii Xantus, Proc. Acad. Nat. Sci. Phila., May [8], 1858, p. 117.

[= *Vireo solitarius cassinii* Xantus.]

Type, [sex ?]; skin in good condition; in full, fresh, first annual plumage; collected by John Xantus, probably, judging by plumage of the bird, in August or September [of either 1857 or 1858]; orig. no. [as written on original Xantus label], 2403; also the number 479 appears on the label, but apparently in another hand; now no. 10229, U. S. Nat. Mus. (had also been entered again under no. 12403, *fide* C. W. Richmond). [Examined by me October 28, 1929.]

Type locality, "vicinity of" FORT TEJON, Kern County.

Vireo swainsonii Baird, Pac. R. R. Repts., **9**, 1858, p. 336 (in text).

[= *Vireo gilvus swainsonii* Baird.]

Type, male adult; skin in good condition; in somewhat worn breeding state of plumage; collected by Emanuel Samuels, in May, 1856; possibly a collector's number, 742 [not "747"], appears on the original label; now no. 5521, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, PETALUMA, Sonoma County.

Helminthophila celata sordida C. H. Townsend, Proc. U. S. Nat. Mus., **13**, [September 9,] 1890, p. 139.

[= *Vermivora celata sordida* (C. H. Townsend).]

Type, male adult, in full feather, little worn; skin in excellent condition; collected by Charles H. Townsend, January 25, 1889; no. 117606, U. S. Nat. Mus. [Examined by me, October 27, 1929.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County.

Dendroica æstiva brewsteri Grinnell, Condor, **5**, May 14, 1903, p. 72.

[=*Dendroica aestiva brewsteri* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, May 18, 1901; orig. no. 4701, coll. J. G.; now no. 37347, Mus. Vert. Zool. A female "type" was also designated: same collector and locality, May 14, 1900; orig. no. 4154, coll. J. G., now no. 37332, Mus. Vert. Zool. This is, of course, a cotype, but the first specimen referred to is now designated as *the* type.

Type locality, [willow patch at mouth of San Francisquito Creek, near] PALO ALTO, Santa Clara County.

Dendroica coronata hooveri McGregor, Bull. Cooper Orn. Club, **1**, March, 1899, p. 32.

[=*Dendroica coronata hooveri* McGregor.]

Type, male adult, in a late stage of prenuptial molt toward full breeding plumage; skin in fair condition; collected by Theodore J. Hoover, April 16, 1898; orig. no. "1988" (also "204" in lead-pencil in one corner of original, rubber-stamped label); now no. 14739, coll. California Academy of Sciences. [Examined by me, last, on January 13, 1930; forwarded.]

Type locality, PALO ALTO ["small bushes along San Francisquito Creek"], Santa Clara County.

Geothlypis trichas sinuosa Grinnell, Condor, **3**, May 15, 1901, p. 65.

[=*Geothlypis trichas sinuosa* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, May 31, 1900; orig. no. 4270, coll. J. G.; now no. 37786, Mus. Vert. Zool.

Type locality, [willow patch where San Francisquito Creek enters the San Francisco Bay marshes, near] PALO ALTO, Santa Clara County.

Geothlypis trichas scirpicola Grinnell, Condor, **3**, May 15, 1901, p. 65.

[=*Geothlypis trichas scirpicola* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, March 20, 1897; orig. no. 2217, coll. J. G.; now no. 37811, Mus. Vert. Zool.

Type locality, [San Gabriel River bottom, three miles south of] EL MONTE, Los Angeles County.

Icteria longicauda Lawrence, Annals Lyc. Nat. Hist. New York, **6**, April, 1853, p. 4.

[=*Icteria virens longicauda* Lawrence.]

Type, adult [male, to judge from measurements]; skin in fair condition though dirty; judging from stage of wear, taken in May or June; "obtained by E. S. Holden, Esq."; originally in the Geo. N. Lawrence collection, at one time given a number in the register of the U. S. Nat. Mus., now no. 40028 in the American Museum of Natural History, New York City (forwarded and examined by me May 3,

1930). The oldest of the three labels now borne by this specimen is the Lawrence label with, on one side, "Icteria longicauda Lawr. | California. @ 177 [the Baird Catalogue number]", and on the other, "Type | Presented by | E. S. Holden."

Type locality, "California"; "probably near Sacramento or Stockton" (A. O. U. Check-list, ed. 3, 1910, p. 324); undoubtedly STOCKTON, San Joaquin County, because this same Holden is known definitely to have collected other birds there; for example, see under *Larus californicus.*

Wilsonia pusilla chryseola Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 2, [October 16,] 1902, pp. 705, 714.

[= *Wilsonia pusilla chryseola* Ridgway.]

Type, male adult; in full breeding plumage, though not necessarily at point of capture on its breeding grounds; skin in good condition; collected by Charles H. Townsend, May 1, 1884; orig. no. 747; now no. 98276, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality: Only "Pacific coast district" given in connection with original description. Later, by Ridgway's selection of a type specimen as above, fixed as RED BLUFF, Tehama County.

Agelaius calacephalus Nuttall, Manual Orn., ed. 2, 1840, p. 186; name corrected to **calocephalus**, p. vi (errata).

[=, probably but not certainly, *Xanthocephalus xanthocephalus* (Bonaparte).]

Type, evidently no specimen collected; only "seen", apparently "in the month of April", 1836.

Type locality, by inference from Nuttall's text, SANTA BARBARA, Santa Barbara County. He does not mention the "Yellow-headed Troopial" as having been encountered in California (though he did meet with it elsewhere in the West), and it seems quite probable that what he saw at Santa Barbara were small individuals, females or young males, or even adult males at a distance, also of *Xanthocephalus.*

Agelaius gubernator californicus Nelson, Auk, **14**, January, 1897, p. 59.

[= *Agelaius phoeniceus californicus* Nelson.]

Type, female adult; skin in fair condition, terminal part of lower mandible missing; wing of male ("mates") attached; collected by Lyman Belding, April 17, 1878; now no. 74278, U. S. Nat. Mus. [Examined by me in July, 1914; re-examined October 27, 1929.]

Type locality, STOCKTON, San Joaquin County.

Agelaius phoeniceus mailliardorum van Rossem, Condor, **28**, September 21, 1926, p. 223.

[= *Agelaius phoeniceus mailliardorum* van Rossem.]

Type, female adult; skin in good condition though asymmetrical; collected by Theodore J. Hoover, April 28, 1901; orig. no. 797; now no. 14645, coll. Donald R. Dickey. (Forwarded and examined by me August 22, 1930.)

Type locality, PALO ALTO, Santa Clara County.

Agelaius phoeniceus aciculatus Mailliard, Condor, **17**, January 30, 1915, p. 13.

[= *Agelaius phoeniceus aciculatus* Mailliard.]

Type, male adult, in somewhat worn state of plumage; skin in good condition; collected by Adriaan J. van Rossem, May 30, 1914; no. 7593, coll. J. & J. W. Mailliard, now housed in the museum of the California Academy of Sciences. [Examined by me, last, on January 13, 1930; forwarded.]

Type locality, [five miles east of] ISABELLA, in valley of South Fork of Kern River, Kern County.

Agelaius phœniceus neutralis Ridgway, Proc. Wash. Acad. Sci., **3**, April 15, 1901, p. 153.

[= *Agelaius phoeniceus neutralis* Ridgway.]

Type, female adult, in worn breeding plumage; skin in excellent condition; collected by Edgar A. Mearns, May 26, 1894; orig. no. 10933; now no. 134297, U. S. Nat. Mus. [Examined by me, October 27, 1929.]

Type locality, JACUMBA, San Diego County.

Icterus tricolor Audubon, Birds Am. (folio), **4**, 1837, pl. 388, fig. 1; also see Audubon, Orn. Biog., **5**, 1839, p. 1.

[= *Agelaius tricolor* (Audubon).]

Type, male adult; skin in quite good condition; collected by Thomas Nuttall, in 1836, probably in "the month of April" (see Nuttall, Manual Orn., ed. 2, 1840, p. 186); no. 2836, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, SANTA BARBARA, Santa Barbara County.

Euphagus cyanocephalus minusculus Grinnell, Condor, **22**, July [published August 10], 1920, p. 153.

[= *Euphagus cyanocephalus minusculus* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, January 26, 1901; orig. no. 4577, coll. J. G.; now no. 34136, Mus Vert. Zool.

Type locality, [among oaks near mouth of San Francisquito Creek near] PALO ALTO, Santa Clara County.

Molothrus ater californicus Dickey and van Rossem, Condor, **24**, November 19, 1922, p. 208.

[= *Molothrus ater californicus* Dickey and van Rossem.]

Type, female adult, "laying"; skin in excellent condition; collected by D. R. Dickey and A. J. van Rossem, May 20, 1920; orig. no. (A. J. van Rossem), 5366; now no. H 707, coll. Donald R. Dickey. [Examined by me, last, April 15, 1930.]

Type locality, BUENA VISTA LAKE [west side near outlet], Kern County.

Zamelodia melanocephala microrhyncha Grinnell, Condor, **2**, November 16, 1900, p. 128.

[= *Hedymeles melanocephalus melanocephalus* (Swainson).]

Type, male adult; skin in good condition; collected by J. Grinnell, July 18, 1897; orig. no. 2987, coll. J. G.; now no. 36595, Mus. Vert. Zool.

Type locality, Buckhorn Cañon [a tributary of Little Rock Creek, at 6500 feet altitude, about two miles north-northeast of Waterman Mountain], SAN GABRIEL MOUNTAINS, Los Angeles County.

Guiraca caerulea salicarius Grinnell, Proc. Biol. Soc. Wash., **24**, June 16, 1911, p. 163.

[= *Guiraca caerulea salicarius* Grinnell.]

Type, male adult; skin in good condition; collected by Charles H. Richardson, Jr., July 21, 1908; orig. no. 1791, C. H. R., Jr.; now no. 3276, Mus. Vert. Zool.

Type locality, Santa Ana River bottom, near [one mile southeast of] COLTON, San Bernardino County.

Hesperiphona vespertina californica Grinnell, Condor, **19**, January 15, 1917, p. 20.

[= *Hesperiphona vespertina brooksi* Grinnell.]

Type, male adult; skin in good condition; collected by Tracy I. Storer, June 15, 1915; orig. no. 1257; now no. 25638, Mus. Vert. Zool.

Type locality, CRANE FLAT, 6300 feet altitude [within western edge of Yosemite National Park], Mariposa County.

Note.—For reasons for synonymizing the name *californica* under the name *brooksi,* see Grinnell, Dixon and Linsdale, Univ. Calif. Publ. Zool., **35**, 1930, pp. 395–396.

Carpodacus californicus Baird, Pac. R. R. Repts., **9**, 1858, p. 413; see also pl. 72, fig. 2, of Baird's Birds N. Am., 1860.

[= *Carpodacus purpureus californicus* Baird.]

Type, male adult; skin in good condition; collected by John Xantus, probably in 1857; orig. no. [apparently] 1037; now no. 10230, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, FORT TEJON, Kern County.

Pyrrhula inornata Vigors, Zool. Voyage Blossom, 1839, p. 20.

[=, probably, *Carpodacus mexicanus frontalis* (Say).]

Type, once likely in the British Museum; now "has disappeared" (*fide* P. L. Sclater, *in* Sharpe, Cat. Birds British Mus., **12**, 1888, p. 139).

Type locality, not indicated in connection with original description. With very little doubt taken by surgeon Alexander Collie, and quite likely during the Blossom's second and longest stay at MONTEREY, Monterey County, October 29 to November 17, 1827. For there and then most of the obscure kinds of birds reported from the voyage were collected; only gawdy or conspicuous things were, for the most part, obtained at San Blas and elsewhere on the coasts of the Pacific where the Blossom touched. Apparently Collie had most opportunity for collecting birds, ashore, at Monterey. His overland trip south from San Francisco to Monterey, while the Blossom was in San Francisco Bay, was evidently too hurried to permit of any collecting en route (cf. Beechey, Narrative, 1831, **2**, pp. 39ff).

While Vigors' description of his *Pyrrhula inornata* is too brief to be altogether identifiable, insofar as it goes it applies to the female California linnet, as already indicated by Ridgway (U. S. Nat. Mus. Bull., **50**, pt. 1, 1901, p. 139).

Carpodacus clementis Mearns, Auk, **15**, July, 1898, pp. 258–259.
[= *Carpodacus mexicanus clementis* Mearns.]

Type, male adult, in "somewhat worn and faded breeding plumage"; skin in good condition; collected by Edgar A. Mearns, August 25, 1894; orig. no. 11345; now no. 134784, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, San Clemente Island, Los Angeles County; more exactly, Smugglers [now Pyramid] Cove (see Mearns, U. S. Nat. Mus. Bull., **56**, 1907, p. 139).

Pinicola enucleator californica Price, Auk, **14**, April, 1897, p. 182.
[= *Pinicola enucleator californica* Price.]

Type, male adult; skin in good condition; collected by William W. Price and Charles S. Dole, July 18, 1896; orig. no. 1002, W. W. Price; now no. 3429, Mus. Stanford University. [Examined by me, January 13, 1922.]

Type locality, Pyramid Peak at "about 7500 feet," near Echo, Eldorado County.

Leucosticte tephrocotis dawsoni Grinnell, Condor, **15**, March 25, 1913, p. 77.
[= *Leucosticte tephrocotis dawsoni* Grinnell.]

Type, male, full-grown juvenal; skin in good condition; collected by J. Grinnell, August 7, 1911; orig. no. 1435, J. G., new field series; now no. 20217, Mus. Vert. Zool.

Type locality, Whitney Meadows, 9800 feet altitude, Sierra Nevada, Tulare County.

Spinus tristis salicamans Grinnell, Auk, **14**, October, 1897, p. 397.
[= *Spinus tristis salicamans* Grinnell.]

Type, male, old adult in full winter plumage; skin in excellent condition; collected by Joseph Grinnell, December 21, 1895; orig. no. 575, coll. J. G.; now no. 160934, U. S. Nat. Mus. [Re-examined by me October 28, 1929.]

Type locality, Pasadena, Los Angeles County; more exactly, Eaton Cañon "wash", some 3 miles southeast of Altadena.

Astragalinus psaltria hesperophilus Oberholser, Proc. Biol. Soc. Wash., **16**, September 30, 1903, p. 116.
[= *Spinus psaltria hesperophilus* (Oberholser).]

Type, male adult; skin (in fresh annual plumage), in excellent condition; collected by Dr. A. K. Fisher, December 28, 1890; orig. no. 7; now no. 139158, U. S. Nat. Mus. (Biol. Surv. coll.). [Examined by me, last, October 30, 1929.]

Type locality, San Bernardino, San Bernardino County.

Carduelis Lawrencei Cassin, Proc. Acad. Nat. Sci. Phila., **5**, "October" [= December 7], 1850, p. 105, pl. 5.
[= *Spinus lawrencei* (Cassin).]

Type, male adult; skin taken down from mount, in fairly good condition, plumage but little worn or faded; collected by John G. Bell [in 1849]; only "California" on present label; no. 24120, Acad. Nat.

Sci. Phila. [Examined by me October 18, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 30.)

Type locality: "This bird I first observed at Sonoma. . . . The flock, out of which I shot these two [♂ and ♀ described by Cassin], was feeding . . . on the seeds of plants growing near the ground. . . . I also saw this bird at San Diego . . ." (Bell, *in* Cassin, *loc. cit.*). Therefore type locality, without possibility of doubt, SONOMA, Sonoma County.

Pipilo maculatus falcinellus Swarth, Condor, **15**, September [published October 15], 1913, p. 172.

[=*Pipilo maculatus falcinellus* Swarth.]

Type, male; skin in good condition; collected by Walter P. Taylor, April 8, 1912; orig. no. 5555; now no. 22832, Mus. Vert. Zool.

Type locality, MARYSVILLE BUTTES at 500 feet altitude, four miles northwest of Sutter, Sutter County.

Pipilo maculatus falcifer McGregor, Condor, **2**, March 16, 1900, p. 43.

[=*Pipilo maculatus falcifer* McGregor.]

Type, male adult, in slightly worn annual plumage; skin in fair condition; collected by Theodore J. Hoover, April 9, 1898; orig. no. 2274, coll. R. C. McGregor; now no. 39484, coll. J. Dwight, Jr., in American Museum of Natural History, New York City. [Examined by me March 5, 1930; forwarded.]

Type locality, PALO ALTO, Santa Clara County.

Pipilo megalonyx Baird, Pac. R. R. Repts., **9**, 1858, p. 515; also see pl. 73 in Baird's Birds N. Am., 1860.

[=*Pipilo maculatus megalonyx* Baird.]

Type, male, in first annual plumage, not worn and hence taken in early fall; skin in somewhat damaged condition; collected by John Xantus (probably in autumn of 1857); no. 10287, U. S. Nat. Mus. [Examined by me, October 27, 1929.]

Type locality, FORT TEJON, Kern County.

Pipilo maculatus atratus Ridgway, Auk, **16**, July, 1899, p. 254.

[=*Pipilo maculatus megalonyx* Baird.]

Type, male, old adult; skin in good condition; collected by Joseph Grinnell, February 8, 1896; orig. no. 643; now no. 159474, U. S. Nat. Mus. [Re-examined by me, October 27, 1929.]

Type locality, [Arroyo Seco, 800 feet altitude, west of] PASADENA, Los Angeles County.

Pipilo clementæ Grinnell, Auk, **14**, July, 1897, p. 294.

[=*Pipilo maculatus clementae* Grinnell.]

Type, male, probably in first annual plumage, not "adult" in the strict sense; good skin, in rather worn breeding condition of plumage; collected by Joseph Grinnell, March 31, 1897; orig. no. 2290; now no. 159476, U. S. Nat. Mus. [Re-examined by me, October 27, 1929.]

Type locality, Smugglers [now Pyramid] Cove, SAN CLEMENTE ISLAND, Los Angeles County.

Pipilo fuscus carolæ McGregor, Bull. Cooper Orn. Club, **1**, January, 1899, p. 11.

[=*Pipilo fuscus carolae* McGregor.]

Type, male, "adult" [but probably bird-of-the-year], in complete annual plumage; skin of fair make; collected by Richard C. McGregor, November 7, 1898; orig. no. 2200, R. C. McG.; now no. 39652, coll. J. Dwight, Jr., in American Museum of Natural History, New York City.

Type locality, Battle Creek, near Ball's Ferry, within two miles of Sacramento River, Shasta County.

Pipilo fuscus petulans Grinnell and Swarth, Univ. Calif. Publ. Zool., **21**, April 6, 1926, p. 430.

[=*Pipilo fuscus petulans* Grinnell and Swarth.]

Type, male adult; skin in good condition; collected by J. Grinnell, January 26, 1901; orig. no. 4576, coll. J. G.; now no. 36439, Mus. Vert. Zool.

Type locality, Palo Alto [among oaks down near edge of San Francisco Bay], Santa Clara County.

Fringilla crissalis Vigors, Zool. Voyage Blossom, 1839, p. 19.

[=*Pipilo fuscus crissalis* (Vigors).]

Type, in British Museum: A poorly made skin, never mounted, rather flattened; plumage fair, not much worn but not absolutely fresh; an adult bird, sex not recorded; British Museum register no. 58.4.3.135 (*fide* H. S. Swarth, MS, May 7, 1930; P. R. Lowe, in letter of March 18, 1930). Collected, doubtless by surgeon Alexander Collie, probably during the latter of H. M. S. Blossom's two visits at Monterey, October 29 to November 17, 1827. Received by the British Museum from the Zoological Society of London.

Type locality, not originally stated, but later announced as Monterey [Monterey County] (Sharpe, Cat. Birds British Mus., **12**, 1888, p. 754).

Passerculus alaudinus Bonaparte, Comptes Rendus, **37**, December, 1853, p. 918.

[=*Passerculus sandwichensis alaudinus* Bonaparte.]

Type: no specimen originally mentioned. But Mr. J. Berlioz tells me (*in litt.*, June 25, 1930) that there is in the Paris Museum of Natural History a specimen, mounted, of this sparrow brought from California in 1853 by [Pierre Adolphe] Delattre, which is marked on the pedestal, "Type." Delattre is known to have collected in the vicinity of San Francisco during the period from the latter part of 1851 to the beginning of 1853 (see Palmer, Condor, **20**, 1918, p. 123).

Type locality, originally published as simply "Californie"; later restricted to "vicinity of San Francisco Bay" (Palmer, *loc. cit.*); now still further restricted to, and so fixed as, San Francisco, San Francisco County.

Note.—Examination of the above type specimen *might* show that it does not belong to the race for which we now use the name *alaudinus*, but to some one of the other three allied races known to occur in the San Francisco Bay region. Thus a shift of names might become neces-

sary. The original description is too brief for accurate use in this connection. I tried to borrow this type from the Paris Museum but failed to obtain the privilege. Of course, only direct comparison of it with large series of California-taken *Passerculus* in the light of extensive knowledge of molts, age stages, and effects of wear and fading upon the plumage in this genus, would bring conclusive subspecific appraisement of this type specimen.

Passerculus sandwichensis bryanti Ridgway, Proc. U. S. Nat. Mus., **7**, "January" [February 25], 1885, pp. 517–518.

[= *Passerculus sandwichensis bryanti* Ridgway.]

Type, male [?], in slightly worn plumage; skin in good condition; collected by Walter E. Bryant, January 23, 1884; no. 96633, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, OAKLAND [probably salt marshes near-by], Alameda County.

Passerculus beldingi Ridgway, Proc. U. S. Nat. Mus., **7**, "January" [February 25], 1885, pp. 516–517.

[= *Passerculus sandwichensis beldingi* Ridgway.]

Type, male adult, in somewhat worn condition of plumage; skin in fairly good condition; collected by Lyman Belding, March 9, 1884; no. 96613, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, SAN DIEGO [doubtless salt marshes near-by], San Diego County.

Emberiza rostrata Cassin, Proc. Acad. Nat. Sci. Phila., **6**, "October" [= December 31], 1852, p. 184.

[= *Passerculus sandwichensis rostratus* (Cassin).]

Type, [sex ?], skin taken down from mount, in fair condition; adult in rather worn, probably early spring, condition; collected by Dr. A. L. Heermann in 1851, probably in March; only "California" on present type label; no. 24087, Acad. Nat. Sci. Phila. [Examined by me October 19, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 30.)

Type locality, "sea shore at SAN DIEGO" [San Diego County]—so stated in the original description; "shores of the Bay of San Diego" (Heermann, Pac. R. R. Repts., **10**, 1859, Zool., no. 2, p. 46).

Ammodramus caudacutus becki Ridgway, Proc. U. S. Nat. Mus., **14**, October 22, 1891, p. 483.

[= *Ammospiza caudacuta nelsoni* (Allen).]

Type, (not sexed), skin in good condition; collected by Rollo H. Beck, May 6, 1891; now no. 120310, U. S. Nat. Mus. [Examined by me, January 4, 1908, and subsequently.]

Type locality, "MILPITAS, Santa Clara County"; taken on the salt marsh near there (see Barlow, Condor, **2**, 1900, p. 132).

Ammodromus ruficeps Cassin, Proc. Acad. Nat. Sci. Phila., **6**, "October" [= December 31], 1852, p. 184.

[= *Aimophila ruficeps ruficeps* (Cassin).]

Type, [sex ?], skin taken down from mount, in good condition; adult in rather worn, possibly breeding, plumage; collected by

Dr. A. L. Heermann, doubtless "in spring of 1852" when, he says (Journ. Acad. Nat. Sci. Phila., ser. 2, **2**, 1853, p. 266), he "procured several specimens". Elsewhere (Pac. R. R. Repts., **10**, Zool., no. 2, 1859, p. 49) he gives the locality as "in the mountains near the Calaveras river". Only "California" on new type label; no. 24031, Acad. Nat. Sci. Phila. [Examined by me October 18, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 31.)

Type locality, according to above evidence, CALAVERAS RIVER, in vicinity of the "southern mines", well up in foothills of Sierra Nevada, in Calaveras County.

Aimophila obscura Dickey and van Rossem, Condor, **25**, July 28, 1923, p. 128.

[= *Aimophila ruficeps obscura* Dickey and van Rossem.]

Type, female adult, "post-breeding"; skin in good condition (fall molt in progress—fresh alongside of worn feathers in dorsum, chest and sides); collected by A. J. van Rossem, August 19, 1922; orig. no. 7198, A. J. van R.; now no. K 516, coll. Donald R. Dickey. [Examined, last, by me, April 15, 1930.]

Type locality, Prisoners Harbor, SANTA CRUZ ISLAND, Santa Barbara County.

Aimophila ruficeps canescens Todd, Condor, **24**, July 29, 1922, p. 126.

[= *Aimophila ruficeps canescens* Todd.]

Type, male adult, in slightly worn annual plumage; skin in good condition; collected by Alfred W. Anthony, January 23, 1894; orig. no. 4826, coll. A. W. A.; now no. 14586, Carnegie Museum. [Forwarded and examined by me, May 7, 1930.]

Type locality, SAN DIEGO, San Diego County.

Emberiza Belli Cassin, Proc. Acad. Nat. Sci. Phila., **5**, "October" [= December 7], 1850, p. 104, pl. 4.

[= *Amphispiza belli belli* (Cassin).]

Type, "male"; skin taken down from mount, a little faded but otherwise in good condition; adult in somewhat worn plumage, probably taken in breeding season; collected by John G. Bell [in 1849]; only "California" on type label; no. 24036, Acad. Nat. Sci. Phila. [Examined by me October 19, 1929.] (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 30.)

Type locality: "This bird I shot first near Sonoma, and afterwards at San Diego; . . . observed . . . amongst the wormwood at the edge of the hills . . ." (Bell, *in* Cassin, *loc. cit.*, p. 105). Therefore, type locality SONOMA, Sonoma County.

Amphispiza belli clementeae Ridgway, Auk, **15**, July, 1898, p. 230.

[= *Amphispiza belli belli* (Cassin).]

Type, male adult, in slightly worn, full mid-winter plumage; skin in excellent condition; collected by Charles H. Townsend, January 25, 1889; no. 117612, U. S. Nat. Mus. [Examined by me October 28, 1929.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County.

Amphispiza belli canescens Grinnell, Condor, **7**, January 17, 1905, p. 18.

[= *Amphispiza belli canescens* Grinnell.]

Type, male, adult (in molt); skin in good condition; collected by J. Grinnell, June 27, 1904; orig. no. 5789, coll. J. G.; now no. 35756, Mus. Vert. Zool.

Type locality, [near] Seymour Creek Meadow, 5500 feet altitude, MOUNT PINOS, Ventura County.

Junco hyemalis thurberi Anthony, Zoe, **1**, October, 1890, p. 238.

[= *Junco oreganus thurberi* Anthony.]

Type, male adult, in moderately worn breeding plumage; skin in good condition; collected by Eugene C. Thurber, May 24, 1890; orig. no. 3072, coll. A. W. Anthony; now no. 14814, Carnegie Museum, Pittsburgh. (Forwarded and examined by me, May 7, 1930.)

Type locality, "Wilson's Peak"; that is, MOUNT WILSON, close to 5500 feet altitude, San Gabriel Mountains, Los Angeles County.

Junco pinosus Loomis, Auk, **10**, January, 1893, p. 47.

[= *Junco oreganus pinosus* Loomis.]

Type, male, in worn post-breeding plumage; skin in fair condition; collected by Leverett M. Loomis, July 4, 1892; orig. no. 935; now no. 278, Mus. Stanford University. [Examined by me, January 13, 1922.]

Type locality, "vicinity of Monterey"; more exactly, woods close to POINT PINOS, near Pacific Grove, Monterey County.

Spizella passerina stridula Grinnell, Condor, **29**, January 15, 1927, p. 81.

[=*Spizella passerina stridula* Grinnell.]

Type, male adult; skin in good condition; collected by J. Grinnell, March 28, 1896; orig. no. 765, coll. J. G.; now no. 35320, Mus. Vert. Zool.

Type locality, ["fields" (then) of Altadena, near] PASADENA, Los Angeles County.

Spizella atrogularis caurina A. H. Miller, Condor, **31**, September 16, 1929, pp. 206–207.

[= *Spizella atrogularis caurina* A. H. Miller.]

Type, male adult; skin in good condition; collected by Alden H. Miller, May 25, 1929; orig. no. 523; now no. 53948, Mus. Vert. Zool.

Type locality, [chaparral of chiefly Adenostoma] on LAS TRAMPAS PEAK, 1700 feet altitude [nine miles west of Mount Diablo], Contra Costa County.

Zonotrichia leucophrys nuttalli Ridgway, Auk, **16**, January, 1899, pp. 36–37.

[= *Zonotrichia leucophrys nuttalli* Ridgway.]

Type, male adult, in but slightly worn full breeding plumage (adult nuptial); skin in excellent condition; collected by William A. Cooper [no date, but probably taken in April or early May, for label is marked "parent of eggs", and year about 1878]; no. 78183, U. S.

Nat. Mus. [Examined by me, last, on October 28, 1929.] (See also Grinnell, Condor, **30**, 1928, p. 188.)

Type locality, none given in connection with original description; but later fixed as Santa Cruz, Santa Cruz County (see Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 1, 1901, p. 343).

Fringilla meruloïdes Vigors, Zool. Voyage Blossom, 1839, p. 19. [=*Passerella iliaca meruloïdes* (Vigors).*]

Type: not in the British Museum (*fide* P. R. Lowe, *in litt.*, March 18, 1930); not so far as known now extant.

Type locality, Monterey, Monterey County, as according to definite statement of describer: "This species was met with at Monterey." The type was doubtless collected by surgeon Alexander Collie, and probably during the second visit of H. M. S. Blossom at Monterey, October 29 to November 17, 1827.

Note.*—This name cannot summarily be discarded as "indeterminable", as done by Swarth (Univ. Calif. Publ. Zool., **21, 1920, pp. 141–142). In Ridgway's description of his *Passerella iliaca annectens* (Auk, **17**, 1900, p. 30), from Yakutat Bay, Alaska, as well as in the same author's general revision (U. S. Nat. Mus. Bull., **50**, pt. 1, 1901, p. 392) no indication is given that any idea was entertained that an older name might be available for the Yakutat race. Ridgway (*op. cit.*, p. 390) merely states that, "in the absence of specimens", he is unable to allocate Vigors' name *Fringilla meruloides; he* did not "discard" it with finality for *any* use in the genus *Passerella.* Later, Grinnell (Condor, **4**, 1902, p. 45), with five midwinter-taken fox sparrows in hand from the neighborhood of Monterey, definitely applied the name *meruloides* to the race they all represented and which he described; this race turned out to be the one named *annectens* by Ridgway, as Grinnell surmised. Swarth, much more recently (*loc. cit.*), finds that in 46 fox sparrows from Monterey now available, five subspecies are represented, and for this reason cannot see his way to using the old name *meruloides* for any of them, even though he grants that one of them (for which he uses Ridgway's name *annectens*) "is by far the most abundant in the region . . .". [If old names of similarly indefinite application were to be generally discarded in favor of later ones, we would be in for a whole lot of name-changing!]

As a further statement of the case:

(1) Vigors' description of *Fringilla meruloïdes* (1839) applies without a trace of ambiguity to a *Passerella*, and not only that but to a race of *P. iliaca* of the brown type; note the words *brunnea, rufescentibus* and *rufobrunnea.* (2) Vigors' name is therefore not *un*identifiable and simply must be used for some one of the recognized races of fox sparrow to which an earlier name does not definitely belong. (3) Of the several subspecies represented in (midwinter) collections of fox sparrows from Monterey, the most abundant is also the one to which Vigors' description applies at least as aptly as to any of the others. (4) It happens that this subspecies, for which the name *meruloïdes* should therefore be used, while wintering rather restrictedly in the west-central coast district of California, summers in the Yakutat Bay district of Alaska, whence Ridgway, altogether unknowingly, renamed it *annectens.*

Passerella iliaca fulva Swarth, Proc. Biol. Soc. Wash., **31,** December 30, 1918, p. 162.

[=*Passerella iliaca fulva* Swarth.]

Type, male adult; skin in good condition; collected by Walter P. Taylor and Harold C. Bryant, May 19, 1910; orig. no. 2887, W. P. Taylor; now no. 14795, Mus. Vert. Zool.

Type locality, Sugar Hill at 5000 feet altitude [east side of Goose Lake], WARNER MOUNTAINS, Modoc County.

P[asserella]. megarhynchus Baird, Pac. R. R. Repts., **9,** 1858, p. 925; see also fig. 4, pl. 69, of Baird's Birds N. Am., 1860.

[=*Passerella iliaca megarhynchus* Baird.]

Type, female [probably in first year]; skin in good condition; plumage but very little worn and hence taken in fall or winter; collected by John Xantus, probably in December, 1857; orig. no. apparently (from old label) no. 1397; now no. 12402, U. S. Nat. Mus. (had some time previously been catalogued as no. 10280). [Examined by me, October 27, 1929.]

Type locality, FORT TEJON, Kern County.

Passerella iliaca brevicauda Mailliard, Condor, **20,** July 22, 1918, p. 139.

[=*Passerella iliaca brevicauda* Mailliard.]

Type, female adult; skin in good condition; collected by Alfred C. Shelton and George E. Stone, August 7, 1913; orig. no. 385, A. C. Shelton; now no. 23924, Mus. Vert. Zool.

Type locality, [at about 7000 feet altitude] one-half mile south of SOUTH YOLLA BOLLY MOUNTAIN, in Trinity County.

Passerella iliaca canescens Swarth, Proc. Biol. Soc. Wash., **31,** December 30, 1918, p. 163.

[=*Passerella iliaca canescens* Swarth.]

Type, male, in nearly complete first annual plumage; skin in good condition; collected by Alfred C. Shelton, August 15, 1917; orig. no. 3549; now no. 28439, Mus. Vert. Zool.

Type locality, Wyman Creek at 8250 feet altitude, near Roberts Ranch, on east slope of WHITE MOUNTAINS, Inyo County.

Passerella iliaca monoensis Grinnell and Storer, Condor, **19,** September 25, 1917, p. 165.

[=*Passerella iliaca monoensis* Grinnell and Storer.]

Type, male adult; skin in good condition; collected by Joseph Dixon, May 21, 1916; orig. no. 4644; now no. 26930, Mus. Vert. Zool.

Type locality, near MONO LAKE [Post Office], 6500 feet altitude, western margin of Mono Lake, Mono County.

Passerella iliaca mariposae Swarth, Proc. Biol. Soc. Wash., **31,** December 30, 1918, pp. 161–162.

[=*Passèrella iliaca mariposae* Swarth.]

Type, male adult; skin in good condition; collected by J. Grinnell, June 10, 1915; orig. no. 3284, J. G., new field series; now no. 25693, Mus. Vert. Zool.

Type locality, ridge at 7000 feet altitude, near [within two miles northeast of] CHINQUAPIN, Yosemite National Park, Mariposa County.

Passerella iliaca stephensi Anthony, Auk, **12**, October, 1895, p. 348.

[= *Passerella iliaca stephensi* Anthony.]

Type, male adult, in worn breeding plumage; skin in good condition; collected by Alfred W. Anthony, July 14, 1895; orig. no. 6651, A. W. A.; now no. 15387, Carnegie Museum. [Forwarded and examined by me, May 7, 1930.]

Type locality, San Jacinto Mountains [Riverside County] at 8000 feet altitude; more exactly, Tahquitz Valley (see Swarth, Univ. Calif. Publ. Zool., **21**, 1920, pp. 176, 181).

Melospiza melodia fisherella Oberholser, Proc. Biol. Soc. Wash., **24**, December 23, 1911, p. 251.

[= *Melospiza melodia fisherella* Oberholser.]

Type, male adult, in somewhat worn breeding plumage; skin in good condition; collected by A. Sterling Bunnell, June 18, 1906; orig. no. 272; now no. 203507, U. S. Nat. Mus. (Biol. Surv. coll.). [Examined by me, last, October 30, 1929.]

Type locality, Honey Lake [west side], near Milford, Lassen County.

Melospiza fasciata ingersolli McGregor, Bull. Cooper Orn. Club, **1**, March 15, 1899, p. 35.

[= *Melospiza melodia merrilli* Brewster.]

Type, male, in newly acquired annual plumage; skin in good condition; collected by Richard C. McGregor, October 19, 1898; orig. no. 2222, R. C. McG.; now no. 39211, coll. J. Dwight, Jr., in American Museum of Natural History, New York City. [Examined by me, last, March 5, 1930; forwarded.]

Type locality, Battle Creek [probably within five miles of the Sacramento River, and not far from the U. S. fish hatchery], Tehama County.

Melospiza melodia cleonensis McGregor, Bull. Cooper Orn. Club, **1**, September 15, 1899, pp. 87–88.

[= *Melospiza melodia cleonensis* McGregor.]

Type, female adult, in moderately worn annual plumage; skin in good condition; collected by Richard C. McGregor, May 28, 1889; orig. no. 288, R. C. McG.; now no. 39223, coll. J. Dwight, Jr., in American Museum of Natural History, New York City. [Examined by me, forwarded, March 5, 1930.]

Type locality, Westport, Mendocino County.

Melospiza gouldii Baird, Pac. R. R. Repts., **9**, 1858, p. 479; see also fig. 2 on pl. 70 in Baird's Birds N. Am., 1860.

[= *Melospiza melodia gouldii* Baird.]

Type, [sex not recorded but probably female], skin in fair condition; collector unknown, but received at U. S. Nat. Mus. by gift from "Mr. John Gould" (of England) previous to February 27, 1858 (= date catalogued); no. 8053, U. S. Nat. Mus. [Last examined by me, October 27, 1929.]

Type locality, "California"; subsequently, upon basis of comparisons, restricted to a location five miles west of Inverness, toward Point

REYES, Marin County (see Grinnell, Univ. Calif. Publ. Zool., **5**, 1909, p. 267).

Ammodramus Samuelis Baird, Proc. Boston Soc. Nat. Hist., **6**, August, 1858, p. 379.

[= *Melospiza melodia samuelis* (Baird).]

Type, male, in worn breeding plumage; skin in good condition; collected by Emanuel Samuels, May 9, 1856; no. 5553, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, PETALUMA, Sonoma County [with no doubt, upon basis of comparison of specimens, from the tide-water marshes near that place].

Melospiza fasciata pusillula Ridgway, Auk, **16**, January, 1899, pp. 35–36.

[= *Melospiza melodia pusillula* Ridgway.]

Type, male "adult"; good skin in somewhat worn early-breeding condition of plumage; collected by W. Otto Emerson, April 18, 1885; no. 105324, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, "salt marshes" [doubtless not far from, and west of, HAYWARD], Alameda County.

Melospiza melodia santæcrucis Grinnell, Condor, **3**, July 15, 1901, p. 92.

[= *Melospiza melodia santaecrucis* Grinnell.]

Type, male adult, in moderately worn breeding condition of plumage; skin in good condition; collected by J. Grinnell, June 2, 1900; orig. no. 4292, coll. J. G.; now no. 35969, Mus. Vert. Zool.

Type locality, San Francisquito Creek, near PALO ALTO, Santa Clara County.

Melospiza fasciata cooperi Ridgway, Auk, **16**, January, 1899, p. 35.

[= *Melospiza melodia cooperi* Ridgway.]

Type, [sex ?]; fairly good skin in somewhat worn early-breeding condition of plumage; collected by Dr. James G. Cooper, April 18, 1862; no. 51895, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, SAN DIEGO, San Diego County.

Melospiza melodia micronyx Grinnell, Proc. Biol. Soc. Wash., **41**, March 16, 1928, p. 37.

[= *Melospiza melodia micronyx* Grinnell.]

Type, male adult; skin in good condition; collected by Chester C. Lamb, September 21, 1927; orig. no. 7930; now no. 51535, Mus. Vert. Zool.

Type locality, SAN MIGUEL ISLAND, Santa Barbara County.

Melospiza fasciata graminea C. H. Townsend, Proc. U. S. Nat. Mus., **13**, September 9, 1890, p. 139.

[= *Melospiza melodia graminea* C. H. Townsend.]

Type, male adult; skin in excellent condition; collected by Charles H. Townsend, February 13, 1889; no. 117634, U. S. Nat. Mus. [Examined by me October 27, 1929.]

Type locality, SANTA BARBARA ISLAND, Los Angeles County.

Melospiza fasciata clementæ C. H. Townsend, Proc. U. S. Nat. Mus., **13**, September 9, 1890, p. 139.

[= *Melospiza melodia clementae* C. H. Townsend.]

Type, male adult; skin in excellent condition; collected by Charles H. Townsend, January 25, 1889; no. 117620, U. S. Nat. Mus. [Examined by me, October 27, 1929.]

Type locality, SAN CLEMENTE ISLAND, Los Angeles County.

Melospiza heermanni Baird, Pac. R. R. Repts., **9**, 1858, pp. 477, 478; see also pl. 70, fig. 1, in Baird's Birds N. Am., 1860.

[= *Melospiza melodia heermanni* Baird.]

Type, male, old adult, in full, early-fall plumage; skin in good condition though broken; collected by Dr. A. L. Heermann [doubtless in September or October, 1853]; no. 6227, U. S. Nat. Mus. [Examined by me, last, on October 27, 1929.]

Type locality, "Tejon valley" [probably close to FORT TEJON], Kern County (see Grinnell, Univ. Calif. Publ. Zool., **5**, 1909, p. 266).

Melospiza melodia mailliardi Grinnell, Univ. Calif. Publ. Zool., **7**, February 18, 1911, p. 197.

[= *Melospiza melodia mailliardi* Grinnell.]

Type, male, in full annual plumage; skin in good condition; collected by Joseph Mailliard, April 6, 1910; orig. no. 7200, coll. J. & J. W. Mailliard; now no. 16687, Mus. Vert. Zool.

Type locality, Rancho Dos Rios [at confluence of Tuolumne and San Joaquin rivers], near MODESTO, Stanislaus County.

Melospiza melodia maxillaris Grinnell, Univ. Calif. Publ. Zool., **5**, April 9, 1909, pp. 265–266.

[= *Melospiza melodia maxillaris* Grinnell.]

Type, male adult; skin in good condition; collected by Louise Kellogg, January 1, 1909; prepared by J. Grinnell; now no. 5476, Mus. Vert. Zool.

Type locality, tule marsh [within two miles] west of SUISUN, Solano County.

Melospiza melodia saltonis Grinnell, Univ. Calif. Publ. Zool., **5**, April 9, 1909, p. 268.

[= *Melospiza melodia saltonis* Grinnell.]

Type, male; skin in good condition; collected by Charles H. Richardson, Jr., March 13, 1908; orig. no. 1155, C. H. R., Jr.; now no. 599, Mus. Vert. Zool.

Type locality, the [then] edge of Salton Sea, one mile southeast of MECCA, Colorado Desert, Riverside County.

HYPOTHETICAL LIST

Pelecanus californicus Ridgway, *in* Baird, Brewer and Ridgway, Water Birds N. Am., **2**, 1884, pp. 132, 143.

[= *Pelecanus occidentalis californicus* Ridgway.]

Type, male adult, in unworn plumage; skin in fair condition, taken down from a mount, gular sac painted; collected by Lyman Belding at La Paz, Lower California, February 24, 1882; now no. 86384, U. S. Nat. Mus. (*fide* Dr. C. W. Richmond, in letter of November 29, 1930). While no type is designated as such in connection with the original description, this one specimen is mentioned first and prominently, so that its subsequent selection at the National Museum as *the* type was the only proper course.

Type locality: "Hab. Coast of California, from San Francisco Bay to Cape St. Lucas." The selection of a type specimen, as above, fixes the type locality as La Paz, Lower California.

Onychotes gruberi Ridgway, Proc. Acad. Nat. Sci. Phila., "December, 1870" [by March 14, 1871], p. 149.

[= *Buteo solitarius* Peale.]

Type, [sex, judging from size, male]; skin, in fair condition, taken down from mount; end of upper mandible gone; "received from" F. Gruber ["entered" at Smithsonian Institution, April 7, 1866]; no. 41703, U. S. Nat. Mus. [Examined by me last, forwarded, May 21, 1930.]

Type locality, "California"; but since the type came through a San Francisco taxidermist (Ferdinand Gruber) it has latterly been thought far more likely that the bird had been collected in the Hawaiian Islands, the native habitat of the species, rather than in the vicinity of San Francisco (see Ridgway, Proc. U. S. Nat. Mus., **8**, 1885, p. 36). However, it must be recalled that a case has been reported in which a free-living Hawaiian hawk accompanied a ship from Hilo nearly to San Francisco (Henshaw, Auk, **18**, 1901, p. 162). So there is a chance, still, that the bird in question was a vagrant really captured in California.

Tetrao Sabini Douglas, Trans. Linn. Soc. London, **16**, 1829 ("issued before May but later than January"), pp. 137–138.

[= *Bonasa umbellus sabini* (Douglas).]

Type, whereabouts, if yet in existence, not known to me.

Type locality, "woody parts of the coast of Northwest America . . . from Cape Mendocina [*sic*]" northward to "Vancouver's Island" (Douglas, *ibid.*, p. 139). Not, probably, anywhere within the limits of the State of California but likely the same neighborhood whence was obtained *Ortyx picta* Douglas [which see]; therefore somewhere in western Oregon.

Lophortyx Gambelii, Nutt. [*sic*] Gambel, Proc. Acad. Nat. Sci. Phila., **1**, "April" [= May 19], 1843, p. 260.

[= *Lophortyx gambelii gambelii* Gambel.]

Type, skin taken down from mount, in excellent condition, very little faded; male adult, in unworn plumage, hence taken in early autumn; collected by William Gambel; no. 24327, Acad. Nat. Sci. Phila. [examined by me October 20, 1929]. (See Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 20.) According to Dr. Stone, the stand bore the inscription, "♂ Cal., W. Gambel."

Type locality: "We met with small flocks of this handsome species some distance west [of the one-time eastern boundary] of California, in the month of November [1841], inhabiting the most barren brushy plains, covered with a species of Chenopodium" (Gambel, *loc cit.*). This has been taken to apply to "southern Nevada" (A. O. U. Check-list, ed. 3, 1910, p. 137). But Gambel himself (Journ. Acad. Nat. Sci. Phila., **1**, 1847, p. 219) says further: "This beautiful species I discovered on the eastern side of the Californian range of mountains in 1841. . . . Several spiral podded species of *Prosopis*, with low spreading branches, afforded them excellent covert, and the seeds of bushy malvas, chenopodiums and artemisias, probably served them as food in that dreary region." Elsewhere, under raven (*ibid.*, p. 47), Gambel refers to "the arid region" traversed "between the Rio Colorado and California." These statements, and the setting depicted, together with what is known of the route likely followed by the party of trappers Gambel was with at that time (see Stone, Cassinia, **14**, 1910, pp. 1–8), might be taken to point quite as well to a locality on the Mohave Desert within the State of California as now outlined. This could have been somewhere south or southeast of Death Valley. However, I have been unable to find any decisive clue to this effect. So the type locality of the Gambel Quail will have to be left, at least for the time being, in hypothetical status as regards California.

Callipepla venusta Gould, Proc. Zool. Soc. London, **14**, 1846, p. 70.

[= *Lophortyx gambelii gambelii* Gambel.]

Type, borrowed from the "Director of the Museum at Neufchâtel" [= Neuchâtel, Switzerland] (Gould, *loc. cit.*, p. 71). I have so far found no clue as to the source of this specimen, though a surmise might be ventured that it was one of the original Gambel-collected birds, and that it got abroad through the Philadelphia Academy. Inquiry by me brought word dated April 3, 1931, that no specimen of *Callipepla venusta* could then be found in the Université de Neuchâtel.

Type locality: "Supposed to be California" (Gould, *loc. cit.*, p. 71). Remains unknown, save for the hint above. The type must, of course, have come from within the range of the species and that consideration rules out nearly all of the localities known to have been visited by collectors of birds previous to 1846.

Ortyx Douglasii Vigors, Zool. Journ., **4**, January, 1829, pp. 354–355.

[= *Lophortyx douglasii douglasii* (Vigors).]

Type, "female adult, skin"; marked "*m*" in list of specimens of this species in the British Museum (Ogilvie-Grant, Cat. Birds British

Mus., **22**, 1893, p. 405). Obtained during the cruise of the Blossom, probably by surgeon Alexander Collie, and transmitted to the London Zoological Society by Captain Beechey. Thence, at the dispersal of the Zoological Society's collection, it came to the British Museum where it now bears the register number 1855.12.19.878 (*fide* P. R. Lowe, in letter of November 22, 1930).

Type locality: "A single specimen only was brought home from Monterey" (Vigors, Zool. Voyage Blossom, 1839, p. 27, pl. 11). But a mistake must have been made in giving Monterey as the locality; Gambel (Journ. Acad. Nat. Sci. Phila., ser. 2, **1**, 1849, p. 219) and Ogilvie-Grant (*loc. cit.*) were doubtless right in substituting Mazatlan, Mexico, a locality in which the species is well known to be native. The Blossom was at Mazatlan in February, 1828 (see Beechey, Narrative, 1831, **2**, p. 324).

Ortyx elegans Lesson, Centurie Zoologique, 1832 ("Juin 1830"), p. 189, pl. 61 [part in which these appeared was issued in March, 1831—*fide* J. L. Peters].

[=, probably, *Lophortyx douglasii douglasii* (Vigors).]

Type, male [figured and described, female also described]; discovered by "M. le docteur Botta"; passed into the collection of "M. le duc de Rivoli."

Type locality, "la Californie." Botta must have visited ports on the west coast of Mexico, quite possibly Mazatlan where the Douglas quail is native, on his way up to the California of today.

Ortyx fasciatus Gould, Proc. Zool. Soc. London, **11**, 1843, p. 133.

[=*Philortyx fasciatus* (Gould).]

Type: Account based on material in "the collections of the Royal Museum at Brussels and of His Highness the Prince Massena, to whose kindness I [Gould, *loc. cit.*] am indebted for the loan of the specimen here described." I thought this type *might* now be in the British Museum (see Ogilvie-Grant, Cat. Birds British Mus., **22**, 1893, p. 406, specimen "*a*"); but it is not there (*fide* P. R. Lowe, in letter of November 22, 1930). Nor did it come with the Rivoli collection to the Philadelphia Academy (*fide* Dr. Witmer Stone).

Type locality, "California." Without question a mistake; some locality in western Mexico.

Ortyx picta Douglas, Philosophical Magazine, new series, **5**, no. 25, January ["on or near the first of this month"], 1829, p. 74.

[=*Oreortyx picta picta* (Douglas).]

Type, not in existence. The specimens collected by David Douglas, in November, 1826, were lost (*teste* Douglas, himself, Trans. Linn. Soc. London, **16**, 1829 ["issued before May but later than January"], p. 143). The description was drawn up from the notes he kept.

Type locality: "Interior of New California"; but not within the bounds of the present State of California; really "at the headwaters of the Umpqua River near the Calapooia Mountains" in middle western Oregon. (See Oberholser, Auk, **40**, 1923, pp. 81–82.)

Ortyx plumifera Gould, Icones Avium, Pt. I, "August", 1837, ninth plate and accompanying text.

[= *Oreortyx picta picta* (Douglas).]

Type, in British Museum, selected there from three specimens which came from the Gould collection: British Mus. reg. no. 55.12.19.30 [the first number in the series being the year, in the 1800's, when the specimen was catalogued]; a "dismounted" bird, in good condition; from state of plumage, might have been shot anywhere from January to May; judging from length of plume probably a male; primary coverts, juvenal, therefore yearling (*fide* H. S. Swarth, MS, May 9, 1930). Collected by David Douglas on his return from Monterey to the interior of Oregon [in 1833 ?], and one of the three which were found in his baggage, forwarded to England, after his death in the Hawaiian Islands [in 1834] (Gould, *loc. cit.;* Oberholser, Auk, **40**, 1923, pp. 82–83). This is specimen *"g"* of Ogilvie-Grant, Cat. Birds British Mus., **22**, 1893, p. 399 (*teste* H. S. Swarth).

Type locality, "California"—but really interior of western Oregon. Oberholser (*loc. cit.*) has, for certain seemingly good reasons, designated the "lower part of the Willamette Valley, Oregon," as a more "exact type locality."

Ægialitis microrhynchus Ridgway, Am. Naturalist, **8**, February, 1874, p. 109.

[= *Charadrius dubius curonicus* Gmelin.]

Type, [sex ?] adult; in mixed worn and unworn plumage; skin in fair condition; printed on the oldest label is "Collins Overland Teleg. Co. C. S. Bulkley, Chief Eng."; and written on it is "San Francisco. Cal. E. F. Lorquin"; the bird is no. 39523, U. S. Nat. Mus. [Examined by me October 29, 1929.]

Type locality: While until now not questioned as San Francisco, I have come to doubt this is an authentic locality for the type. There is nothing that I can find to show definitely that the specimen was either collected by E. F. Lorquin himself or that it was actually taken at San Francisco. Lorquin was curator of zoology at the California Academy of Sciences in 1865 and was also well known as a San Francisco taxidermist, with French connections, through whose hands passed birds of world-wide sources. (See acount of the Lorquin family, pp. 694–697, in E. O. Essig's History of Entomology, MacMillan, 1931; also Henshaw, Condor, **22**, 1920, p. 59.) The plover in question may well have been one of a miscellaneous lot of birds merely obtained from this taxidermist in San Francisco by someone, without knowledge of the proprieties, who inscribed the label with the data it now bears. The species belongs to Europe and Asia.

Larus furcatus Neboux, Revue Zoologique, **3**, 1840, p. 290; Zool. Voyage Venus, Atlas, 1842, pl. 10. [Described fully in the first place cited, but there given only a vernacular name.]

[= *Creagrus furcatus* (Neboux).]

Type, no. 14622, in the Paris Museum of Natural History (*fide* Mr. J. Berlioz, in letter of May 5, 1930).

Type locality, "Monterey (Haute-Californie)." The Venus was at this port October 18 to November 14, 1837; and the type might have

been collected there by surgeon Adolphe Simon Neboux who also later described the species (see Palmer, Condor, **20**, 1918, pp. 114–116). But collecting was done also, on the same voyage, at the Galapagos Islands; and Dwight (Bull. Am. Mus. Nat. Hist., **52**, 1925, p. 325) suggests that a confusion of labels may have occurred, so that the record as from Monterey must remain in doubt.

Strix californica Audubon, Birds Am. (folio), **4**, 1838, pl. 432, fig. 2.

[= *Speotyto cunicularia hypugaea* (Bonaparte).]

Type, supposedly one of four specimens received by Audubon from Dr. J. K. Townsend and by the former "at first supposed to be of a distinct species . . ." (Audubon, Orn. Biography, **5**, 1839, p. 265). I have been unable to locate this type; perhaps now lost.

Type locality, as indicated in the name on the plate as above, California. But Townsend's account quoted by Audubon (*loc. cit.*) says for the general range of the burrowing owl as found by him, "Columbia River and the whole extent of the Rocky Mountains." A complicating circumstance here is the statement of T. R. Peale (U. S. Expl. Exp., Wilkes, **8**, Mam. and Orn., 1848, p. 77) that he had been informed that Audubon's plate "was drawn from a specimen obtained in Chili, by Mr. J. K. Townsend." At any rate, the source of the type was without any doubt somewhere outside of the present State of California.

Antrostomus californianus Bonaparte, Conspectus Gen. Avium, **1**, 1850, p. 61.

[=, doubtfully, *Phalaenoptilus nuttallii californicus* Ridgway.]

Type, if any, never indicated. Mr. J. Berlioz of the Paris Museum (*in litt.*, May 5, 1930) informs me that he knows nothing of any possible type there.

Type locality, "ex California." I can only surmise that the bird described, if it came from California at all, would have been obtained most likely, previous to 1850, at or near one of the sea-ports south from San Francisco.

Note.—Hartert (Cat. Birds British Mus., **16**, 1892, p. 579, footnote) remarks that Bonaparte's name "has been quoted as a synonym of the present species [*P. nuttallii*], but the description of Bonaparte does not well correspond." Bonaparte (*loc. cit.*) compares the bird he describes with Audubon's plate of *nuttallii* (Audubon, Birds Am., **7**, 1844, p. 351, pl. 495), as if it were similar though somewhat different. Bonaparte's brief description I find, however, does not well fit a poor-will; rather does it look composite, as applying in part also to a nighthawk! I cannot therefore see safe ground for reviving Bonaparte's name for the subspecies of poor-will later named *californicus* by Ridgway, a course which at first naturally suggested itself.

Ornismya Costae Bourcier, Revue Zoologique, **2**, "Octobre", 1839, p. 294.

[= *Calypte costae* (Bourcier).]

Type, doubtless a male, obtained in November or December, 1837, on the voyage of the French frigate Venus, by Adolphe Simon Neboux, surgeon of the vessel; it came into possession of Jules Bourcier, the

describer; after the latter's death, his collection was sold, part being acquired by the University Museum of Caen, in Normandy, and part by Daniel Giraud Elliot (*fide* Dr. C. E. Hellmayr, in letter of December 3, 1930). The Elliot collection is now in the American Museum of Natural History, New York City; but neither in Caen or New York has a Costa Hummingbird so far been recognized as the type. Bourcier's type has also been supposed to have been added to the collection of Louis Marie Pantaléon de Costa, Marquis de Beau-Regard, for whom the species was named; the "Beau-regard" collection was sold in 1878 to Adolphe Boucard (see Boucard, Genera of Humming Birds, 1893, p. 5). Since Boucard is known to have presented collections of birds to the Paris Museum of Natural History (*fide* Fleming, Condor, **21**, 1919, p. 39), the type, if it was in Boucard's possession, might have gone there; but Mr. J. Berlioz (in letter of May 5, 1930) tells me that no type of Bourcier's is now, to his knowledge, in the Paris Museum.

Type locality, given originally as "la Californie"; but really Magdalena Bay, lat. 24° 35′, Lower California (see Palmer, Condor, **20**, 1918, p. 115).

D[ryobates]. homorus Cabanis and Heine, Mus. Heineanum, **4**, ii, 1863 (1864), p. 65 (in footnote).

[= *Dryobates pubescens leucurus* (Hartlaub).]

Type, not known to be extant; indeed, there may have been no type [as suggested to me by Dr. E. Stresemann, of the Zoological Museum in Berlin, in letter of May 9, 1922] — the brief description may have been based upon a statement or remark made by some one else, in manuscript if not in previous published literature.

Type locality, "California"; but probably not from within the state as now restricted (see Grinnell, Condor, **25**, 1923, p. 30).

Picus imperialis Gould, Proc. Zool. Soc. London, **2**, 1832, p. 140.

[= *Campephilus imperialis* (Gould).]

Type: The species was described from several skins, from among which a male and female, *via* the Salvin–Godman collection, reached the British Museum (Hargitt, Cat. Birds British Mus., **18**, 1890, p. 466); of this pair the male may be considered as *the* type. Mr. Percy R. Lowe writes me (November 22, 1930) that this bird bears the register number 1888.8.5.61. There is no original label, but the reverse of the Salvin–Godman label says, in Salvin's handwriting: "Obtained as the type of the species from Mr. Gould in exchange for a specimen of Phasianus chrysomelas. See B. Asia Part xxviii."

Type locality, originally given as "that little-explored district of California which borders the territory of Mexico." But, in all probability, the types were collected by "the Mining Engineer Floresi, who formed a considerable collection of Humming-Birds, and also preserved skins of a few other species, all of which passed into Gould's possession . . .," (*fide* Salvin and Godman, Biol. Centrali-Am., Aves, **2**, 1895, p. 445). Floresi was for a time stationed at Bolaños, Jalisco, Mexico, in the neighborhood of which this woodpecker is known to occur; therefore this place has been fixed as the type locality (Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 6, 1914, p. 166).

S[aurophagus]. bairdii Gambel, Journ. Acad. Nat. Sci. Phila., ser. 2, **1**, "December", 1847, p. 40.

[=*Myiodynastes bairdii* (Gambel).]

Type, apparently lost; not in either the United States National Museum or the Academy of Natural Sciences, Philadelphia.

Type locality, given originally as "California"; but "doubtless from Guayaquil, Ecuador" (*fide* Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 4, 1907, p. 656, footnote).

Ægithalus flaviceps Sundevall, Öfv. K. Vet.-Akad. Förh., **7**, "May 8," 1850, pp. 129–130 (footnote).

[=*Auriparus flaviceps flaviceps* (Sundevall).]

Type, collected by [very probably I. G. Vosnesensky between November 23, 1841, and March 19, 1842, for] Dr. R. F. Sahlberg; "E Sitka in America bor. occid., vel e California" [but see below]: a mounted bird in fair condition, though somewhat dirty and browned from long exposure; evidently a male, in late winter stage of plumage wear; no. 11, Zoological Museum of the University of Helsingfors, Finland (forwarded and examined by me, April 12, 1931).

Type locality, "Sitka" or "California." Subsequently determined to be vicinity of Loreto, latitude 26°, Gulf coast of Lower California (see Grinnell, Condor, **33**, 1931, p. 168).

Picolaptes brunneicapillus Lafresnaye, Magasin de Zoologie, **5**, 1835, pl. 47 and accompanying text.

[=*Heleodytes brunneicapillus brunneicapillus* (Lafresnaye).]

Type, given to Baron F. de Lafresnaye by Charles Brelay, a collector in Bordeaux; obtained from an officer whose ship was said to have been in California and Peru; once no. 2600, Lafresnaye coll.; then in coll. Boston Society of Natural History; now no. 76143, Mus. Comparative Zoology (*fide* Bangs, Bull. Mus. Comp. Zool., **70**, 1930, p. 313); skin made over from mount; tip of upper mandible missing, otherwise in good condition (examined by me October 15, 1930).

Type locality: Originally believed to be "Californie." Comparison of specimens makes it practically certain that this was wrong, and that the type really came from southern Sonora, Mexico (Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 3, 1904, p. 519, footnote). Guaymas has virtually been fixed as the type locality (by Bangs, *loc. cit.*).

[**Orpheus**] **longirostris** Lafresnaye, Revue Zoologique, **1**, 1838, p. 55.

[=*Toxostoma longirostre longirostre* (Lafresnaye).]

Type, now no. 76533, Mus. Comparative Zoology; orig. no. 3633, Lafresnaye coll.; "Mexique" on original label (*fide* Bangs, Bull. Mus. Comp. Zool., **70**, 1930, p. 323); skin made over from mount, in good condition (examined by me October 15, 1930).

Type locality: Originally described, without better indication of locality, as from Mexico and California. As shown by characters of type, it evidently came from some point in southeastern Mexico. Certainly it never could have come from anywhere within or even near the present confines of California.

Turdus rufo-palliatus La Fresnaye, Revue Zoologique, 1840, p. 259.

[=*Turdus flavirostris* (Swainson), of most recent authors.]

Type, collected by Léclancher on the voyage of the "Venus"; the expedition stopped at Monterey, California, but also at other points, to the southward (*fide* Bangs and Penard, Bull. Mus. Comp. Zool., **63**, 1919, p. 31); orig. no. 3568, Lafresnaye coll.; now no. 76520, Mus. Comp. Zool.; skin made over from mount, in excellent condition (examined by me October 15, 1930).

Type locality, "Monterey en Californie". Doubtless a mistake; the species belongs to western and southwestern Mexico, and Bangs and Penard (*loc. cit.*) have "substituted" Acapulco, southwestern Mexico, as the type locality.

Collurio Ludovicianus, var. **robustus** ["Baird"] Ridgway, Am. Naturalist, **7**, October, 1873, p. 609.

[=*Lanius algeriensis* Lesson.]

Type, [sex ?] adult; skin taken down from mount, in fair condition; old label bears: "Dr. Gambel. California."; no. 15303, Acad. Nat. Sci. Phila. (see Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 23). [Examined by me October 19, 1929, and found to check up in every detail with *Lanius algeriensis,* just as stated by Ridgway, U. S. Nat. Mus. Bull., **50**, pt. 3, 1904, p. 237.]

Type locality, "California." But this supposition clearly due to some mistake having been made in labelling. The species is native of northwestern Africa.

Sylvia Delafieldii Audubon, Orn. Biog., **5**, 1839, p. 307.

[=*Geothlypis aequinoctialis velata* (Vieillot).]

Type, male, in full fresh plumage; taken down from mount, most of left wing missing; said to have been collected by John K. Townsend; no. 2905, U. S. Nat. Mus.; received by S. F. Baird from J. J. Audubon; old label is in Baird's hand-writing. [Examined by me November 1, 1929.]

Type locality, "California" (Audubon, *loc. cit.*); but Nuttall (Manual Orn., ed. 2, 1840, p. 458) says Audubon's specimen was obtained by Mr. Townsend "in the Oregon Territory, near Fort Vancouver." However, with no doubt at all, the bird was really obtained, by Townsend or by someone else, in South America.

Pendulinus californicus Lesson, Revue Zoologique, **7**, "Décembre", 1844, p. 436.

[=*Icterus pustulatus* (Wagler).]

Type, stated to have been in the collection of Doctor Abeillé, of Bordeaux. Where this collection is now, I have been unable to learn.

Type locality, only "California" given in connection with the original description. Doubtless really some port in western Mexico.

Carduelis Yarrellii Audubon, Synopsis Birds N. Am., 1839, p. 117.

[=*Spinus yarrellii* (Audubon).]

Type, adult male, in full plumage; skin in poor condition and with evidences that the bird had been kept alive for some time; no. 2037,

U. S. Nat. Mus. (Examined by me October 31, 1929.) The old label, in S. F. Baird's hand-writing, says: "2037. ♂ California". An "n" indicates that he received the skin from Audubon. A comment on the present type label says: "Audubon rec'd it from Swainson."

Type locality, "Upper California." But this is obviously a mistake. The type doubtless came in round-about way from some place in South America.

Carduelis Stanleyi Audubon, Synopsis Birds N. Am., 1839, p. 118.

[= *Spinus barbatus* (Molina).]

Type, adult male, in full fresh plumage; skin in excellent condition, though slight soiling and disarrangement of barbs at ends of wings and tail would seem to show that the bird had been kept alive in confinement; no. 2035, U. S. Nat. Mus. (Examined by me October 31, 1929.) The old label, in S. F. Baird's hand-writing, says: "2035. ♂ California." An "n" indicates that he received the bird from Audubon.

Type locality, "Upper California." No doubt an error and really some place in southern South America.

Spizella Breweri Cassin, Proc. Acad. Nat. Sci. Phila., **8,** "February" [= March 25], 1856, p. 40.

[= *Spizella breweri breweri* Cassin.]

Type, none originally designated: but later (Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 30) selected from among the specimens Cassin had before him: No. 24050, Acad. Nat. Sci. Phila.; Black Hills, South Dakota. This is also one of the two specimens described (under the name *Emberiza pallida* Swainson) by Audubon (Orn. Biog., 1839, pp. 66–68) who says they "were procured on the 15th of June, 1834, on the Rocky Mountains, by Dr. [J. K.] Townsend." And Cassin at the outset cites Audubon's description as really applying to his *breweri.*

Type locality: "Hab. Western North America, California, New Mexico. Spec. in Mus. Acad. Philada., and Nat. Mus. Washington." Also the statement is made in Cassin's text, ". . . brought in nearly all collections from California and New Mexico." This has been interpreted to mean that a true type must be selected from among the California-taken specimens then extant. But since Cassin cites Audubon, whose "*pallida*" was based on the Rocky Mountain birds, I follow Stone in considering the type locality of *breweri* to be Black Hills, South Dakota.

Fringilla Mortonii Audubon, Orn. Biography, **5,** 1839, p. 312.

[= *Zonotrichia capensis* (Müller).]

Type, skin in fairly good condition, tip of upper mandible broken; plumage somewhat worn and faded; "apparently an adult male"; one label, not an original, says: "Columbia R. J. K. T."; another says, in part, "original specimen from Dr. J. K. Townsend Collection. Chili. Pres. by Dr. Woodhouse"; no. 10614, Acad. Nat. Sci. Phila. [Examined by me October 14, 1930.]

Type locality, given in the original description as "Upper California". The type, while doubtless taken by or for John K. Townsend, "was evidently obtained in Chile, and was wrongly labelled" (*fide* Stone, Proc. Acad. Nat. Sci. Phila., 1899, p. 17). The species is native of Central and South America and is broken up into several subspecies; to which of these the type of *mortonii* belongs, I have had no opportunity of determining.

Transmitted December 9, 1930.

NEW POCKET GOPHERS FROM NEVADA

BY

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NEW POCKET GOPHERS FROM NEVADA

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(Contribution from the University of California Museum of Vertebrate Zoology)

In the years 1925 to 1927, inclusive, Miss Annie M. Alexander and Miss Louise Kellogg collected several hundred pocket gophers in western Nevada. Part of this material was made the basis of an account by Grinnell (Univ. Calif. Publ. Zool., **30**, 177–188, pls. 9–11, December 10, 1926) of two previously unnamed forms of *Thomomys*. Field work supported by Miss Alexander during the past four years has yielded many additional specimens of the genus from other places in and adjacent to Nevada. These include topotypes of some earlier described forms. Thus, comparisons now, for the first time, are possible which permit the satisfactory application of names to the geographic variations shown by the specimens.

Each of the seven forms here named as new belongs in the heretofore designated *perpallidus* series. This series according to Goldman (Jour. Wash. Acad. Sci., **21**, 416, October 19, 1931) is conspecific with the *fulvus* group, since certain members of the latter intergrade with members of the *perpallidus* group. Also, I am able to add that, as recently suggested by Goldman (*op. cit.*, p. 417) and as definitely known at least to some students who previously have worked on far western *Thomomys*, intergradation exists between the two species *Thomomys bottae* and *T. perpallidus*.

In view of this condition and holding intergradation in continuously distributed mainland forms at present to be the most desirable criterion for ascribing to a given form subspecific as opposed to specific rank, the name *bottae*, since it is the oldest in the lot, is here substituted for the previously employed specific name *perpallidus*.

The actual specimens showing this intergradation of the *bottae* and *perpallidus* groups are from Walker Pass and tributary canyons. Here the two forms currently known as *Thomomys bottae pascalis* and *Thomomys perpallidus perpes* meet and merge imperceptibly one into the other. This pertinent material, consisting of series of specimens from selected places along the south fork of the Kern River

up to Walker Pass, and thence down Freeman Canyon on the eastern side of Walker Pass, was called to my attention by Dr. J. Grinnell who, himself, some years ago, collected it for the express purpose of making out the relationships of the pocket gophers in this area.

Although several of the races of *Thomomys bottae* in Nevada have very restricted ranges as now known—indeed three forms are as yet known only from material taken at the type localities—additional collecting almost certainly will show that most, if not all, the subspecies have ranges embracing geographic areas of considerable extent. Available material already indicates this to be true of *T. b. canus* and especially of *T. b. centralis*.

Color terms employed in the following accounts are after Ridgway, Color Standards and Color Nomenclature, 1912. Mr. W. C. Russell of the Museum staff has given valuable service in arranging specimens, and in making preliminary segregations of the variations here reported upon.

Thomomys bottae depressus, new subspecies

Type.—Female adult, skin and skull; no. 36970, Mus. Vert. Zool.; Dixie Meadows [at south end of Humboldt Salt Marsh], 3500 feet altitude, Churchill County, Nevada; October 22, 1926; collected by Louise Kellogg and Annie M. Alexander, original no. 105.

Diagnosis.—*Size:* Medium (see measurements). Color (winter pelage): Lighter than mouse gray above with slight tinge of buff; gray below with tinge of buff on pectoral region. Skull: Relatively broad, especially in female; rostrum broad, not constricted posteriorly but depressed distally; tympanic bullae angular anterolaterally; foramen magnum evenly rounded above.

Comparison.—*Thomomys bottae depressus,* so named in allusion to the depressed distal end of the rostrum, as compared with *T. b. canus,* differs from the last-mentioned race in smaller size and the presence of a small amount of buff color. Selected cranial differences are as follows: In *depressus,* skull smaller; rostrum relatively shorter, as wide posteriorly as anteriorly rather than constricted posteriorly, and more depressed distally; lacrymals larger; tympanic bullae more angular anterolaterally; interparietal wider than long rather than longer than wide; ascending tongues of premaxillae extending farther behind nasals; foramen magnum evenly rounded above, rather than marked with median evagination; incisors shorter; maxillary tooth row relatively longer.

The trace of buff in the pelage of *depressus* is to be expected on geographic grounds since forms still farther to the eastward are predominately buff. Indeed specimens from Fallon and Eastgate, although referred to *canus* on the basis of large size and cranial characters, display a trace of buff which is lacking in topotypes of *canus* and one specimen available from the west side of Pyramid Lake two miles west of Sutcliffe.

As compared with *fumosus, depressus* is lighter colored (more gray), smaller, and has a relatively broader skull. Additional distinctive features of *depressus* are: Rostrum not constricted posteriorly; occiput relatively shallower; pterygoid space more broadly V-shaped, temporal ridges more widely separated; less depressed interorbitally; paroccipital processes less developed.

Material.—Thirty-one specimens from the type locality.

Thomomys bottae cinereus, new subspecies

Type.—Female adult, skin and skull; no. 36373, Mus. Vert. Zool.; West Walker River, Smiths Valley, 4700 feet altitude, Lyon County, Nevada; October 30, 1925; collected by Annie M. Alexander, original no. 69.

Diagnosis.—Size: Medium (see measurements). Color (winter pelage): Slightly lighter than mouse gray above; gray below except for white chin and anal region; about half the specimens faintly tinged with buff on forearms. Skull: Relatively broad, especially in female; rostrum narrow but not constricted posteriorly; tympanic bullae moderately inflated; zygomatic breadth greater posteriorly than anteriorly; pterygoid space with central spicule; pterygoid processes wide transversely.

Comparison.—Selected differences in *cinereus* as compared with *canus*, the race next adjacent on the north, are as follows: Smaller; dorsal outline of skull in longitudinal axis more arched; vertical depth of skull through maxillary teeth less; rostrum relatively broader; occiput less flattened; tympanic bullae more inflated; incisors shorter; and in females, zygomatic breadth less anteriorly than posteriorly rather than about the same anteriorly and posteriorly; ascending tongues of premaxillae and whole rostrum relatively and actually wider.

Excepting the faint tinge of buff on the forearms of about half of the specimens of *cinereus*, the coloration is practically identical with that of *canus*. *T. b. canus, cinereus* and *depressus* are the three palest of the known races of this species in Nevada.

In comparison with *lacrymalis*, the race next adjacent on the south, selected differences of *cinereus* are as follows: Coloration more gray (less buffy); smaller; rostrum relatively more slender and constricted posteriorly; lacrymals smaller; posterior ends of ascending tongues of premaxillae more attenuated; tympanic bullae less inflated; zygomatic arm of maxilla at junction with jugal less thickened; pterygoid space more nearly U-shaped and with, rather than without, central spicule of vertical lamina of palate; each pterygoid process wider transversely; incisors shorter.

Material.—Six specimens from the type locality.

Thomomys bottae lacrymalis, new subspecies

Type.—Female adult, skin and skull; no. 38427, Mus. Vert. Zool.; Arlemont [= Chiatovich Ranch, Fish Lake Valley], 4900 feet altitude, Esmeralda County, Nevada; May 22, 1927; collected by Annie M. Alexander and Louise Kellogg, original no. 390.

Diagnosis.—Size: Large (see measurements). Color (summer pelage): Lighter than cinnamon buff above; neutral gray below except inguinal region which is white. Skull: Broad, especially in male; rostrum relatively broad but constricted proximally; tympanic bullae large and smooth; lacrymals large and expanded at tips; zygomatic process of maxilla greatly thickened at junction with jugal; interpterygoid space narrowly V-shaped.

Comparison—T. b. lacrymalis, so named in allusion to the unusually large lacrymal processes, is similar in general size and coloration to *Thomomys bottae amargosae* Grinnell and *Thomomys bottae melanotis* Grinnell. However, on the average, the color is a bit more cinnamon buff than in either of these forms. Also, available specimens of *melanotis* average slightly smaller than those of *lacrymalis* and *amargosae.*

Selected cranial characters in which *lacrymalis* differs from *melanotis* are as follows: Skull larger; lacrymals relatively larger; maxillary tooth row longer; jugals bowed outward rather than straight; nasals and ascending tongues of premaxillae actually and relatively longer.

Outstanding differences from *amargosae* are: Jugal, in longitudinal axis, inclined forward and upward rather than horizontally; zygomatic process of maxilla, viewed dorsolaterally, slightly, rather than greatly, thickened at junction with jugal; zygomatic breadth actually and relatively less; nasals actually and relatively longer; anterior end of rostrum usually more depressed.

For comparison with *cinereus* and *curtatus* see accounts of those races.

Remarks.—Intergradation with *cinereus* is indicated by a series of specimens from Cat Creek near the southern end of Walker Lake. In these specimens the size and shape of the tympanic bullae are almost exactly intermediate as between those of *cinereus* and *lacrymalis.* Agreement with *cinereus* is shown in smaller size of the animal and smaller lacrymals. In eight other differential characters as between *lacrymalis* and *cinereus,* the specimens from Cat Creek show precise agreement with *lacrymalis.* The only character noted as distinguishing the Cat Creek specimens from both *lacrymalis* and *cinereus* is the more abrupt outward extension of the squamosal arm of the zygomatic arch. The Fish Lake Valley specimens approach the Cat Creek specimens in this respect more closely than do the ones of *cinereus.*

The two specimens from Candelaria Junction are so young as not clearly to show diagnostic cranial characters. Their reference to the subspecies *lacrymalis* is therefore tentative. Indeed certain features of these specimens suggest relationship with the subspecies *solitarius.*

Material.—Thirty-eight specimens as follows: Type locality, 20; McNett Ranch, 5600 feet, five miles southwest of the type locality, 5; one mile west of Candelaria Junction, 5500 feet, Mineral County, Nevada, 2; south end Walker Lake, 4100 feet, Mineral County, Nevada, 2; Cat Creek, four miles west of Hawthorne, Mineral County, Nevada, 9.

Thomomys bottae curtatus, new subspecies

Type.—Male adult, skin and skull; no. 49053, Mus. Vert. Zool.; San Antonio, 5400 feet altitude, Nye County, Nevada; September 16, 1931; collected by Chester C. Lamb, original no. 15792.

Diagnosis.—Size: Medium (see measurements). Color (summer pelage): Slightly lighter than cinnamon buff above; neutral gray below except for white inguinal region and presence of buff on pectoral region. Skull: Broad, especially in male; rostrum wide, constricted posteriorly and but slightly depressed distally; tympanic bullae moderately inflated and angular anteriorly; dorsal outline of skull in longitudinal axis nearly straight; incisors short.

Comparison.—As compared with *lacrymalis*, its geographically adjacent neighbor on the south, *curtatus* is smaller in both external and cranial measurements and has a trifle more cinnamon buff in the color of the upperparts with buff on the pectoral region. This buff is practically absent on the pectoral region of *lacrymalis*. The *interorbital* region is more basined and the upper face of the rostrum markedly less decurved than in *lacrymalis*. Also, in *curtatus* the incisors are much shorter and the tympanic bullae are less inflated posteromedially. Correlated with this degree of inflation of the bullae is the shape of the basioccipital which is V-shaped in *curtatus* and Y-shaped in *lacrymalis*.

From *fumosus*, the form next adjacent to the northward, *curtatus* is seen to differ as follows: Color reddish rather than grayish; females of similar size though males are smaller; skull relatively broader throughout and actually much shorter; incisors shorter; dorsal outline of skull in longitudinal axis nearly straight rather than much arched; rostrum notably less depressed distally and relatively and actually shorter; zygomatic arch thicker at junction of jugal and maxilla; tooth row relatively, and usually actually, longer.

Material.—Eleven skins with skulls and one skin-only from the type locality.

Thomomys bottae fumosus, new subspecies

Type.—Male adult, skin and skull; no. 37126, Mus. Vert. Zool.; Milman Ranch, Moores Creek, 19 miles southeast of Millett P. O., Nye County, Nevada; January 13, 1927; collected by Louise Kellogg and Annie M. Alexander, original no. 303.

Diagnosis.—Size: large (see measurements). Color (winter pelage): Near deep mouse gray above with smoky tinge; darkest on mid-dorsal area; sides and pectoral regions tinged with buff; inguinal region white; otherwise dark gray (lighter than above) below with

occasional white markings on throat and chin. Skull: Large and relatively long; rostrum large and greatly elongated; tympanic bullae moderately inflated and angular anteriorly; frontal region behind orbits depressed so as to form basin; incisors long; maxillary tooth row short.

Comparison.—As compared with *Thomomys bottae centralis,* its relative which is structurally most similar, *fumosus* is of about the same size but with a shorter tail and deep mouse gray rather than cinnamon buff above. Other differences are as follows: Skull actually and relatively deeper throughout; incisors slightly larger and of much greater diameter; rostrum actually and relatively broader; zygomatic arm of maxilla carried farther anteriorly on rostrum; bullae more inflated; basioccipital tending to be Y-shaped rather than V-shaped.

T. b. fumosus may be distinguished from *T. b. canus* by the following selected differences: Coloration darker; smaller, both cranially and in body; rostrum more depressed distally; wider interorbitally; occiput much less flattened; bullae less attenuated anteriorly; pterygoid space narrowly V-shaped and without central spicule rather than U-shaped and with central spicule; more depressed interorbitally.

For comparison with *curtatus* and *brevidens* see accounts of those forms.

Material.—Sixty-six specimens, all from Great Smoky Valley, Nevada, as follows: Kingston Ranch, sixteen miles north Millett P. O., 4; Daniels Ranch, twelve miles northeast of Millett P. O., 4; Millett P. O., 12 (skulls only); Mitchell field, five miles southeast of Millett P. O., 30; type locality, 16.

Thomomys bottae brevidens, new subspecies

Type.—Male adult, skin and skull; no. 49062, Mus. Vert. Zool.; Breen Creek, 7000 feet altitude, Kawich Range, Nye County, Nevada; September 22, 1931; collected by E. Raymond Hall, original no. 3412.

Diagnosis.—Size: Medium (see measurements). Color (May- and September-taken specimens): Darker than cinnamon buff above; whitish gray below. Skull: Relatively narrow; rostrum of average size, depressed distally and constricted posteriorly; tympanic bullae markedly inflated dorsoventrally; incisors short; parietal ridges widely separated even in animals of advanced age.

Comparison.—The skull of *brevidens* as compared with that of *fumosus* is less depressed interorbitally, with heavier jugal, tympanic bullae more inflated dorsoventrally and the skull, when laid top down on a horizontal surface, has the tips of the nasals lower and occiput higher.

As compared with topotypes of *centralis* the tympanic bullae are more inflated and the ascending tongues of the premaxillae extend, on the average, farther posteriorly to the nasals.

T. b. brevidens differs from both *centralis* and *fumosus* as follows: Entire animal of similar size externally but skull markedly smaller

(see measurements); incisors one-fourth to one-third shorter; rostral and mastoid breadths relatively greater; tooth row relatively longer; temporal ridges not approaching one another so closely with advanced age; pterygoid space more broadly V-shaped; fossa, beneath overhanging edge of frontal and immediately posterior to foramen opticum, absent rather than present.

T. b. brevidens is less reddish and more yellowish than *centralis*. The deep mouse gray of *fumosus* sets it sharply apart from *brevidens* in so far as color is concerned.

As compared with *nanus*, the color of *brevidens* averages a trifle lighter. Its larger size and larger skull of different proportions are distinctive.

Material.—Eight skins with skulls and five skins only from the type locality and one skin with skull from Cactus Flat, 5700 feet, seven and one-half miles southwest of Silverbow, Nye County, Nevada.

Thomomys bottae nanus, new subspecies

Type.—Female adult, skin and skull; no. 49077, Mus. Vert. Zool.; south end of Belted Range, five and one-half miles northwest of White-rock Spring, 7200 feet altitude, Nye County, Nevada; September 27, 1931; collected by Chester C. Lamb, original no. 15921.

Diagnosis.—Size: Small (see measurements). Color (summer pelage): Darker than cinnamon buff above; black post auricular patch large; color of underparts highly variable and ranging from cinnamon buff over all to light gray with white pectoral and inguinal regions. Skull: Small, lightly built and relatively narrow; rostrum weak and narrow; tympanic bullae moderately inflated and truncate anteriorly; parietal ridges widely separated even in animals of advanced age; incisors strongly recurved.

Comparison and *Remarks*.—An adult specimen of *nanus* at first glance strongly suggests an immature specimen of one of the heavier skulled races. In this pseudo-immature appearance *nanus* is similar to *Thomomys bottae solitarius* Grinnell from which it differs, however, in being even smaller as shown by both external and cranial measurements. Also, the nasals are relatively shorter, ascending tongues of the premaxillae and entire rostrum relatively as well as actually narrower, temporal ridges weaker and not so closely approaching one another; lacrymals slightly smaller; incisors shorter and the maxillofrontal suture is convex posteromedially rather than concave.

Despite these distinguishing features the two races, *nanus* and *solitarius* are much alike and together are sharply set off from the other geographically adjacent races of *bottae*. Even so, it seems probable that collecting in suitable localities will reveal specimens which display structural characters of an intermediate sort as between *nanus* or *solitarius* on the one hand and *brevidens* or some other of the nearby forms on the other.

Material.—Forty-nine specimens, all from Nevada, as follows: Type locality, 37 (8 skins with skulls, 18 skins only and 11 skulls

AVERAGE, MINIMUM AND MAXIMUM MEASUREMENTS IN MILLIMETERS OF ADULT TOPOTYPES (INCLUDING TYPES) OF SEVEN NEW SUBSPECIES OF *Thomomys bottae*

Subspecies	Total length	Length of tail	Length of hind foot	Basilar length of Hensel	Greatest length of nasals	Zygomatic breadth	Mastoid breadth	Least interorbital breadth	Alveolar length of upper molars	Extension of premaxillae posterior to nasals
T. b. depressus, 6 ♂♂	224 (220–232)	62 (55–68)	29 (28–30)	34.8 (33.8–35.5)	13.7 (13.1–14.2)	25.5 (23.4–26.8)	21.1 (20.2–21.9)	7.0 (6.6–7.4)	8.4 (7.9–8.9)	2.7 (2.2–3.3)
T. b. cinereus, 3 ♂♂	233 (230–240)	73 (71–76)	30 (30–31)	34.5 (33.1–36.0)	14.2 (13.5–14.9)	24.6 (24.1–24.5)	20.9 (20.2–21.5)	6.7 (6.5–7.0)	8.6 (8.4–8.8)	2.8 (1.7–3.9)
T. b. lacrymalis, 5 ♂♂	241 (232–255)	63 (58–68)	31 (30–32)	35.7 (34.9–36.5)	15.4 (14.6–17.5)	26.6 (25.4–28.3)	21.8 (21.2–22.8)	6.6 (6.2–7.0)	8.6 (8.0–9.3)	1.5 (0–2.4)
T. b. curtatus, 4 ♂♂	223 (209–235)	66 (63–75)	29 (27–31)	33.2 (32.0–35.6)	13.7 (12.8–15.0)	24.4 (23.6–26.0)	20.4 (20.0–21.0)	6.7 (6.0–7.4)	8.2 (7.6–9.2)	2.5 (1.8–3.1)
T. b. fumosus, 7 ♂♂	236 (223–247)	60 (53–70)	31.6 (30.5–32)	36.1 (33.5–37.5)	14.8 (13.3–16.6)	25.5 (24.1–26.7)	21.0 (20.3–21.6)	6.9 (6.6–7.3)	8.1 (7.5–8.7)	2.3 (1.3–3.3)
T. b. brevidens, 5 ♂♂	232 (217–241)	76 (73–80)	31 (30–32)	33.5 (32.5–34.5)	13.3 (12.5–14.0)	23.5 (23.2–24.1)	19.7 (19.3–20.1)	6.6 (6.2–6.8)	8.0 (7.8–8.4)	2.3 (1.5–2.9)
T. b. nanus, 5 ♂♂	199 (185–210)	64 (57–70)	29 (28–30)	29.7 (28.2–31.9)	11.0 (10.7–11.6)	20.6 (19.8–21.8)	17.9 (16.9–19.0)	6.4 (6.2–6.6)	7.5 (6.8–8.0)	2.7 (1.3–3.3)
T. b. depressus, 7 ♀♀	207 (195–218)	59 (54–60)	28 (28–29)	32.2 (30.8–33.5)	12.7 (11.9–13.8)	23.5 (22.7–24.5)	19.8 (19.4–20.3)	6.9 (6.4–7.2)	8.0 (7.6–8.4)	2.7 (1.7–4.3)
T. b. cinereus, 3 ♀♀	212 (203–228)	61 (60–63)	29 (28–30)	32.4 (31.7–33.7)	12.7 (12.1–13.4)	23.6 (22.7–24.3)	19.9 (19.5–20.3)	6.5 (6.2–6.9)	8.3 (8.0–8.6)	2.0 (1.5–2.2)
T. b. lacrymalis, 10 ♀♀	216 (200–230)	59 (51–70)	28.6 (26.5–31)	32.3 (29.9–34.1)	13.2 (11.8–14.1)	23.2 (21.8–25.0)	19.6 (18.5–20.5)	6.8 (6.4–7.5)	8.3 (7.8–8.7)	1.8 (1.0–2.8)
T. b. curtatus, 4 ♀♀	211 (194–221)	63 (56–74)	29 (28–29)	31.8 (30.8–33.0)	13.0 (12.5–13.7)	23.1 (21.9–23.9)	19.6 (19.0–20.2)	6.9 (6.5–7.1)	8.3 (8.2–8.6)	2.0 (1.7–2.6)
T. b. fumosus, 8 ♀♀	212 (192–233)	56 (50–66)	29.2 (27–31.5)	32.8 (31.4–34.8)	12.8 (11.8–14.6)	23.0 (22.1–23.9)	20.0 (19.0–20.9)	6.9 (6.4–7.2)	7.7 (7.2–8.0)	2.3 (1.1–3.1)
T. b. brevidens, 4 ♀♀	210 (200–220)	70 (64–75)	29 (27.5–30)	30.4 (29.7–30.8)	11.6 (11.4–11.8)	21.4 (20.8–22.4)	18.6 (18.0–19.2)	6.4 (6.2–6.5)	7.4 (7.2–7.6)	2.6 (2.5–2.8)
T. b. nanus, 10 ♀♀	196 (188–204)	58 (48–69)	28 (25–29)	28.8 (26.9–30.4)	10.6 (9.9–11.2)	20.2 (19.1–20.8)	17.7 (17.4–18.3)	6.4 (6.2–6.7)	7.6 (7.0–8.0)	2.6 (2.3–3.0)

only); four miles southeast of Oak Spring, 5500 feet, Nye County, 1; two miles southwest of Oak Spring, 5800 feet, Nye County, 1; Kawich Range, 6000 feet, one and one-half miles east of Kawich P. O., Nye County, 1; Summit Spring, 4800 feet, Lincoln County, 1; south side of Groom Baldy, 9000 feet, Lincoln County, 4; north slope of Irish Mountain, 7000 to 8000 feet, Lincoln County, 4.

Excluding members of the *townsendii* and *quadratus* groups, Nevada-taken specimens of *Thomomys* have constituted the basis for ten names which now seem best placed as subspecies of the species *Thomomys bottae*. These forms, together with their type localities, are as follows:

Thomomys bottae canus Bailey. Deep Hole, at north end of Smoke Creek Desert, Washoe County, Nevada.

Thomomys bottae depressus Hall. Dixie Meadows, 3500 feet, Churchill County, Nevada.

Thomomys bottae cinereus Hall. West Walker River, Smiths Valley, 4700 feet, Lyon County, Nevada.

Thomomys bottae lacrymalis Hall. Arlemont [=Chiatovich Ranch, Fish Lake Valley], 4900 feet, Esmeralda County, Nevada.

Thomomys bottae curtatus Hall. San Antonio, 5400 feet, Nye County, Nevada.

Thomomys bottae fumosus Hall. Milman Ranch, Moores Creek, 19 miles southeast of Millett P. O., Nye County, Nevada.

Thomomys bottae brevidens Hall. Breen Creek, 7000 feet, Kawich Range, Nye County, Nevada.

Thomomys bottae centralis Hall. Two and one-half miles east of Baker, 5700 feet, White Pine County, Nevada.

Thomomys bottae solitarius Grinnell. Finger-rock Wash, Stewart Valley, 5400 feet, Mineral County, Nevada.

Thomomys bottae nanus Hall. South end of Belted Range, five and one-half miles northwest of Whiterock Spring, 7200 feet, Nye County, Nevada.

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THREE NEW RODENTS FROM LAVA BEDS OF SOUTHERN NEW MEXICO

BY

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THREE NEW RODENTS FROM LAVA BEDS OF SOUTHERN NEW MEXICO

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SETH B. BENSON

(Contribution from the Museum of Vertebrate Zoology of the University of California)

Field work recently carried on by Miss Annie M. Alexander, Miss Louise Kellogg, and the writer in the Tularosa Basin and adjacent parts of southwestern New Mexico, had for its chief object a study of the distribution of the two pocket mice and the wood rat (described by Dice, 1929) whose colors match strikingly those of their surroundings. One result of our field work was the discovery that three additional kinds of rodents tend to match the color of the lava fields on which they live and to which they appear to be restricted. These forms, however, have not reached the degree of blackness found in the lava-dwelling wood rat and pocket mouse, but appear to be intermediate stages between the ordinary color and the black stage.

Citellus grammurus tularosae, new subspecies

Type.—Male, adult, skin and skull, no. 50935, Mus. Vert. Zool.; from the malpais at French's Ranch, 5400 feet altitude, 12 miles northwest of Carrizozo, Lincoln County, New Mexico. Collected October 28, 1931, by Seth B. Benson; original number 1603.

Distribution.—Lava beds of the Tularosa Basin in Lincoln and Otero counties, New Mexico.

Specimens examined.—Total number, 4, all from Lincoln County, New Mexico, as follows: malpais 3½ miles west of Carrizozo, 1; malpais at French's Ranch, 12 miles northwest of Carrizozo, 3.

Additional individuals were seen at these localities and also at Malpais Spring, 14 miles west of Three Rivers, Otero County.

Diagnosis.—A race of *Citellus grammurus* characterized as follows: size large; color dark, but with no areas which are completely black; color of feet mixed blackish brown and clay color; skull large with short, wide rostrum, and with zygomata which do not flare out abruptly anteriorly.

Comparisons.—Similar to *Citellus grammurus grammurus* from Ruidoso, Lincoln County, New Mexico, but darker, owing to narrower bands on banded hairs, smaller number of banded hairs, greater intensity of color in basal and banded portions of hairs, and greater extension over body of hairs with plumbeous bases, particularly on hind feet. Compared with *C. g. buckleyi* and *C. g. couchii:* lacks areas which are entirely black. Compared with *C. g. juglans:* feet grizzled blackish brown and clay color, rather than plain ochraceous; skull relatively narrower.

Color.—Basal portions of hairs over entire surface of body, except on chin and orbital ring, dark quaker drab to black, darkest mid-dorsally, palest on thighs. Banded portions of hairs ranging from white to clay color, darkest on head and rump, palest on sides (especially shoulders) and ventral surface. Banded portions of hairs shortest on head and shoulders, longest on underparts. Banded hairs fewest along mid-dorsal region. Resulting general effect: a dark area extending from head to middle of back where banded hairs are fewest and bands shortest; shoulders grizzled white and black; posterior dorsal surface grizzled clay color and blackish brown, fading to white and blackish brown laterally; ventral surface white underlaid by black, except on breast and legs where pinkish buff replaces white; eye-ring white, conspicuous; outer side of ear black; feet grizzled clay color and blackish brown.

Measurements of type (in millimeters and grams).—Total length, 488; tail, 206; hind foot, 60; ear from notch, 28; ear from crown, 20; weight, 767. Skull: greatest length, 62.8; basal length, 54.8; length of nasals, 22.9; zygomatic breadth, 38.4; mastoid breadth, 26.3; alveolar length of maxillary tooth row, 12.5.

Remarks.—It may not be justified to regard the dark color of *tularosae* as an effect of the color of the lava field on which it lives. The reasons are that there are other dark races of rock squirrels in the Southwest concerning which there is little information available as to whether any relation exists between their dark color and their environments, and, furthermore, one of these races, *C. g. couchii*, according to Bailey (1905, p. 83), exhibits dichromatism. It may be of significance, however, that the range of each of these dark races includes areas of dark colored rock. The race *C. g. juglans* has only been recorded from the southwest base of the Mogollon Mountains of New Mexico. These mountains are chiefly volcanic in origin and some of the lavas present are dark in color (Lindgren, Graton, and Gordon, 1910, pp. 192–193). The limited range of *C. g. buckleyi* in south-central Texas contains much dark colored rock, at least in Llano County in the vicinity of Packsaddle Mountain, the type locality (Paige, 1912, pp. 4, 5, 8). The range of *couchii* in western Texas extends north to include the volcanic area which lies between the Rio Grande and the Davis Mountains. This area includes basaltic lava flows (Udden, Baker, and Böse, 1916, pp. 13, 101). The Guadalupe Mountains, which lie just to the north of the Davis Mountains, are sedimentary in origin and pale in color. These mountains are inhabited by typical *C. g. grammurus* (Bailey, 1905, p. 85).

The dark color of *tularosae* probably does not indicate closer relationship with any one of the dark races than with *grammurus*. The range of *tularosae* is distant from the ranges of the dark forms, and, in addition, is completely surrounded by typical *grammurus*. It appears most reasonable to assume that *tularosae* has been directly derived from *grammurus*, and that its dark color has developed on the lava field. The presence of other kinds of rodents which are darker on the lava field than elsewhere lends support to this view.

Perognathus intermedius rupestris, new subspecies

Type.—Male, young adult, skin and skull, no. 50595, Mus. Vert. Zool.; from that part of the lava beds nearest to Kenzin, Dona Ana County, New Mexico. Collected October 24, 1931, by Annie M. Alexander; original number 1225.

Distribution.—Lava beds near Kenzin, Dona Ana County, New Mexico.

Specimens examined.—Twenty-five from the type locality.

Diagnosis.—A small, short-tailed, dark race of *Perognathus intermedius* with belly hairs plumbeous at base and tipped with pinkish buff; underside of tail and hind feet pinkish buff; skull small, smoothly rounded, with slender rostrum and small mastoid bullae.

Comparisons.—Compared with *Perognathus intermedius ater*: smaller, tail relatively shorter; pinkish buff pigment present instead of absent in subterminal band of dorsal hairs, in tips of belly hairs, in hairs of hind feet, and in hairs of ventral side of tail (in *ater* these areas are deep quaker drab). Skull smaller, relatively narrower; mastoids relatively smaller; rostrum more slender. Compared with *Perognathus intermedius intermedius* from Apache Mine (= Camp Apache), six miles south of Hachita, Grant County, New Mexico: smaller; dorsal coloration darker owing to deeper plumbeous color of bases of hairs, narrower and darker subterminal bands, and heavier overcast of black; belly hairs, hind feet, and lower surface of tail pinkish buff rather than white. Skull smaller, with relatively shorter rostrum.

Color.—Dorsal hairs with terminal portions black, subterminal bands pinkish buff, basal portions dark quaker drab. Terminal and basal colors strongly predominant. Hairs of breast and front feet, white. Hairs of belly quaker drab basally, tipped with pinkish buff. Tail black above, pinkish buff beneath. Hind feet pinkish buff slightly mixed with black.

Measurements.—Three adult males, the type and two paratypes: total length, 169, 152, 157; tail, 92, 88, 83; hind foot, 20.5, 20, 21; ear from crown, 4, 4, 5; weight, 12.9, 12.6, 12.2. Skull: Occipito-nasal length, 23.9, 23.9, 23.8; fronto-nasal length, 16.0, 16.0, 16.0; mastoid breadth, 12.4, 12.6, 12.8; length of mastoid, 7.8, 7.8, 8.1; distance between stylomastoid foramina, 9.7, 9.4, 9.4; least interorbital breadth, 5.8, 6.2, 6.0.

Remarks.—The population of *Perognathus intermedius* on the lava field at Kenzin does not show the wide range of individual variation in color that is found in certain other rodents occupying the same lava beds, or in the dark race of *Peromyscus nasutus* from the Tularosa Basin. The variation which is present in the series of *Perognathus i. rupestris* accompanies age and different stages of molt. *P. i. rupestris* apparently has reached a more or less stable condition which is approximately intermediate between the "normal" *intermedius* and the black race *ater*. It is worthy of note that these three races differ in skull characters as well as in color.

Peromyscus nasutus griseus, new subspecies

Type.—Adult male, skin and skull, no. 50819, Mus. Vert. Zool.; from the malpais 3½ miles west of Carrizozo, 5150 feet altitude, Lincoln County, New Mexico; collected September 26, 1931, by Louise Kellogg; original number 1149.

Distribution.—Lava beds in the Tularosa Basin, New Mexico.

Specimens examined.—Total number, 14, all from New Mexico, as follows: Socorro County: North Cerro Prieto, 6200 feet, 17 miles northwest of Carrizozo, 1. Lincoln County: 3½ miles west of Carrizozo, 5150 feet, 8; French's Ranch, 5400 feet, 12 miles northwest of Carrizozo, 4. Otero County: Malpais Spring, 4150 feet, 14 miles west of Three Rivers, 1.

Diagnosis.—A race of *Peromyscus nasutus* characterized by dark coloration; yellow pigment not present, or present in but very small amount, in the subterminal bands of the dorsal hairs; and by the buffy color of the pectoral region, or of the entire ventral surface.

Comparisons.—Compared with *Peromyscus nasutus nasutus:* general tone of mid-dorsal surface darker, owing to smaller amount of yellow pigment in subterminal band, and to greater amount of black pigment in axial and cortical portions of hairs. Ventral surface not pure white but with a buffy pectoral band, or with a buffy wash over all.

Skull, apparently as in *P. n. nasutus.* (Three damaged skulls of latter form examined.)

Color.—Type specimen: basal portions of hairs blackish plumbeous. Subterminal bands pale drab gray on dorsal surface, brightening to light ochraceous-buff on sides where terminal portions of hairs bear yellow pigment. Mid-dorsal hairs tipped with black which diminishes and disappears toward sides, allowing color of subterminal band to become dominant in narrow area. Hairs of ventral surface white, except in band across breast where tipped with light ochraceous-buff. Tail bicolor, black above, white below. Feet white.

The general color effect is a grizzled gray on the dorsal surface, palest on the face, with an increasing suffusion of buffy posteriorly and laterally, culminating in a line of light ochraceous-buff running from cheek to heel and separating the dark and white areas of pelage. Light ochraceous-buff also extends across the breast between the forelegs.

Specimen no. 50813, a paratype: yellow pigment completely lacking in subterminal band of the dorsal surface. Resulting gray band masked by plumbeous black of apical and basal parts of hair. Yellow pigment present in hairs of sides and ventral surface. These hairs light ochraceous-buff, but, viewed collectively, they appear darker due to underlying plumbeous black portions of hairs. White hairs mixed with buffy ones on chin and about anal region. Feet gray, due to mixing of black and white hairs. Tail, above and below, clothed with black hairs.

The variation in color in *P. n. griseus* covers a wide range, but even the palest specimen is darker than is typical *nasutus*. The paratype described above is very much darker than the type. The differences in color are due to differences in the amount and distribution of the pigments in the hairs. There is an even gradation between the palest and darkest specimens.

Measurements.—Type: total length, 201; tail, 102; hind foot, 23; ear from crown, 18; weight, 25.0. Averages and extreme measurements of 13 specimens, including type, are as follows: total length, 196 (182–212); tail, 102 (91–117); hind foot, 22.9 (22–23); ear from crown, 18.2 (17–21); ear from notch (6 specimens), 21.8 (21–23); ear from notch in dry skin, 18.3 (17.1–19.8); weight, 26.0 (20.5–30.5); head and body, 94 (87–99). Skull: greatest length, 28.1 (27.4–28.9); basilar length, 21.0 (20.2–21.3); zygomatic breadth, 13.8 (13.3–14.4); interorbital constriction, 4.4 (4.2–4.6); interparietal width, 10.6 (10.0–11.0); interparietal length 3.7 (3.0–4.3); length of nasals, 10.9 (10.6–11.3); shelf of bony palate, 4.4 (4.3–4.6); length of anterior palatine foramina, 5.7 (5.3–6.1); length of diastema, 7.2 (6.9–7.4); postpalatal length, 9.9 (9.5–10.4); maxillary tooth row, 4.4 (4.0–4.5). Comparisons should be made with the measurements given by Osgood (1909, pp. 261, 266).

Remarks.—The species *Peromyscus nasutus* appears to be a rock-loving form throughout its range, and as such, would tend to be isolated on the malpais. Osgood (*supra cit.*, p. 177), without comment as to any peculiarities, lists *P. nasutus* from the San Andreas Mountains, New Mexico. These mountains form the southwestern boundary of the Tularosa Basin. Thus it seems probable that *P. n. griseus* is restricted to the dark colored lava rock in the Tularosa Basin.

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EXPLANATION OF PLATES

PLATE 3

Dorsal views of skins of *Citellus grammurus* (about 1/4 natural size); *Perognathus intermedius* (about 3/5 natural size); and *Peromyscus nasutus* (about 3/5 natural size).

a. Citellus grammurus tularosae; immature ♂, no. 50303, Mus. Vert. Zool., malpais 3½ miles west of Carrizozo, Lincoln County, New Mexico; September 27, 1931; Louise Kellogg.

b. Citellus grammurus grammurus; immature ♀, no. 50304, Mus. Vert. Zool.; Ruidoso, Lincoln County, New Mexico; September 28, 1931; Louise Kellogg.

c. Citellus grammurus tularosae; adult ♂, no. 50935, Mus. Vert. Zool.; French's Ranch, 12 miles northwest of Carrizozo, Lincoln County, New Mexico; October 28, 1931; Seth B. Benson.

d. Citellus grammurus grammurus; adult ♀, no. 50302, Mus. Vert. Zool.; Fort Webster (Coppermines), 3 miles west of Santa Rita, Grant County, New Mexico; August 17, 1931; Louise Kellogg.

e. Perognathus intermedius ater; adult ♂, no. 50578, Mus. Vert. Zool.; Malpais Spring, 14 miles west of Three Rivers, Otero County, New Mexico; September 22, 1931; Annie M. Alexander.

f. Perognathus intermedius rupestris; adult ♂, no. 50595, Mus. Vert. Zool.; lava beds near Kenzin, Dona Ana County, New Mexico; October 24, 1931; Annie M. Alexander.

g. Perognathus intermedius intermedius; adult ♂, no. 50566, Mus. Vert. Zool.; Apache Mine (Camp Apache), 6 miles south of Hachita, Grant County, New Mexico; September 9, 1931; Annie M. Alexander.

h. Peromyscus nasutus griseus; adult ♂, no. 50813, Mus. Vert. Zool.; malpais 3½ miles west of Carrizozo, Lincoln County, New Mexico; September 26, 1931; Annie M. Alexander.

i. Peromyscus nasutus griseus; adult ♂, no. 50819, Mus. Vert. Zool.; malpais 3½ miles west of Carrizozo, Lincoln County, New Mexico; September 26, 1931; Louise Kellogg.

j. Peromyscus nasutus nasutus; adult ♂, no. 6967, Mus. Vert. Zool.; bluffs 3 miles north of Colorado Springs, El Paso County, Colorado; December 22, 1904; E. R. Warren.

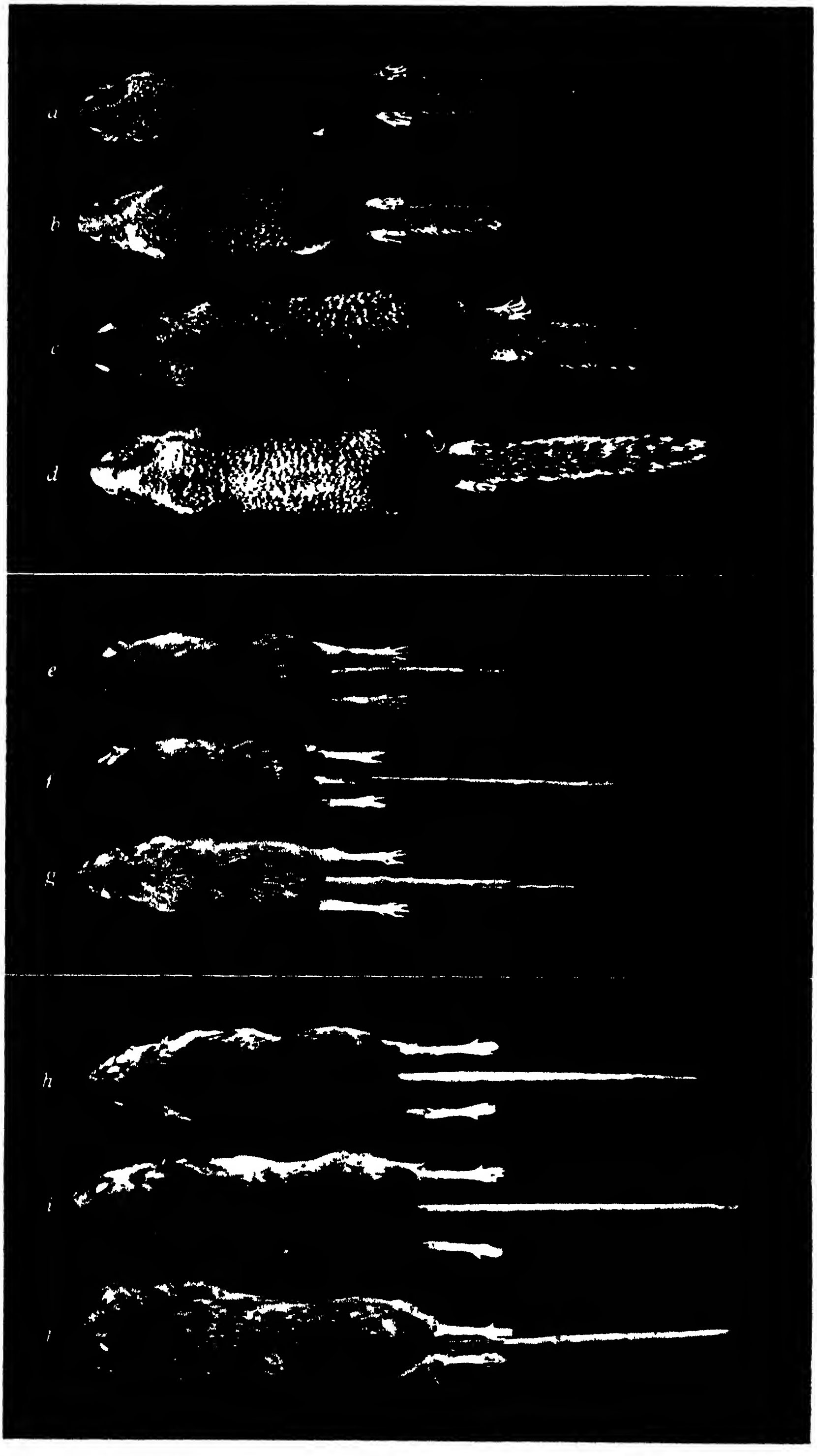


PLATE 4

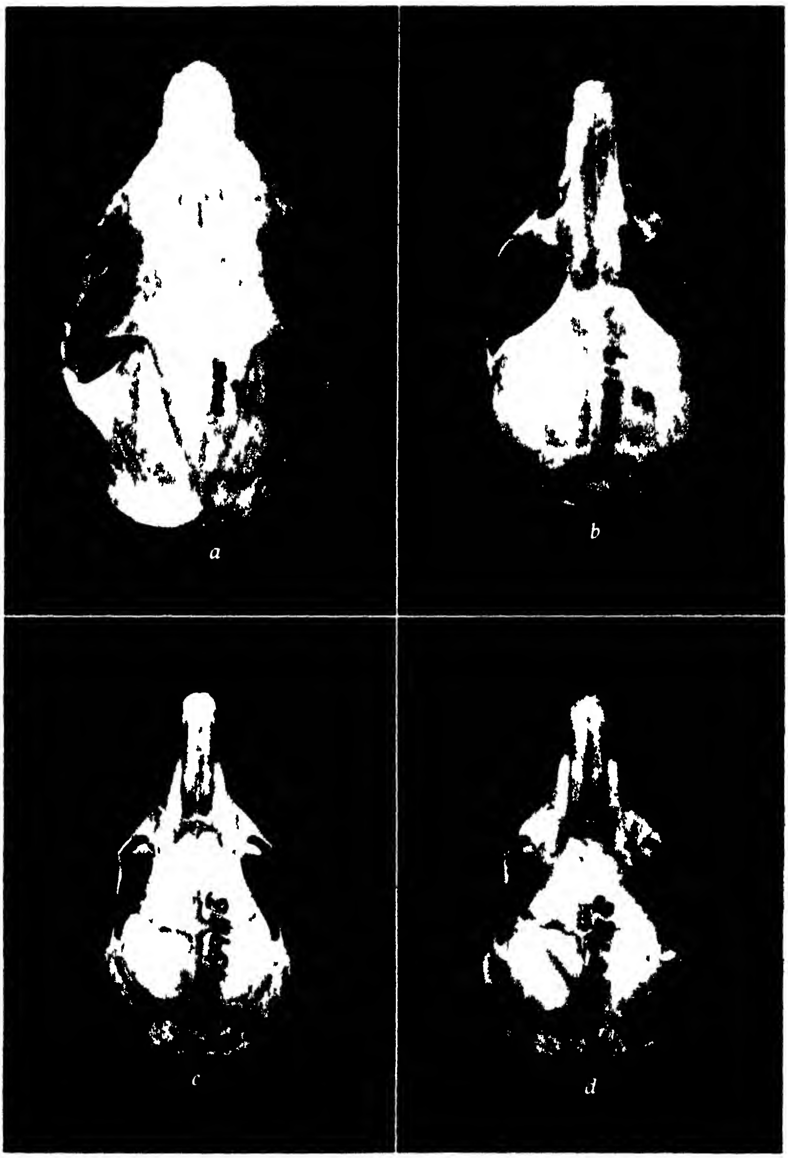
Dorsal views of skulls of subspecies of *Citellus grammurus* (slightly less than natural size), *Peromyscus nasutus* (twice natural size), and *Perognathus intermedius* (twice natural size).

a. Citellus grammurus tularosae; adult ♂, no. 50935, Mus. Vert. Zool.; French's Ranch, 12 miles northwest of Carrizozo, Lincoln County, New Mexico; October 28, 1931; Seth B. Benson.

b. Peromyscus nasutus griseus; adult ♂, no. 50819, Mus. Vert. Zool.; malpais 3½ miles west of Carrizozo, Lincoln County, New Mexico; September 26, 1931; Louise Kellogg.

c. Perognathus intermedius rupestris; adult ♂, no. 50595, Mus. Vert. Zool.; lava beds near Kenzin, Dona Ana County, New Mexico; October 24, 1931; Annie M. Alexander.

d. Perognathus intermedius ater; adult ♂, no. 50578, Mus. Vert. Zool.; Malpais Spring, 14 miles west of Three Rivers, Otero County, New Mexico; September 22, 1931; Annie M. Alexander.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AMPHIBIANS AND REPTILES FROM LOWER CALIFORNIA

BY

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AMPHIBIANS AND REPTILES FROM LOWER CALIFORNIA

BY

JEAN M. LINSDALE

(Contribution from the Museum of Vertebrate Zoology of the University of California)

Collecting expeditions in Lower California have been carried on under the auspices of the University of California Museum of Vertebrate Zoology during a large part of the seven-year period from 1925 to 1931. This period of field work was the result of a plan originally proposed by Miss Annie M. Alexander and later supported by her through special gifts of funds. Herpetological material was collected on all of these expeditions to Lower California, but as a rule it was given only incidental attention. Birds and mammals came first in the efforts of the collectors and made up the major portion of the collections. Nevertheless, the amphibians and reptiles that were obtained have turned out to be of considerable interest. In many cases large series represent widely scattered localities through the ranges of the species on the peninsula. In other cases more specimens were obtained of the forms than have hitherto been available to investigators for study. Thus better definition of the characteristics and ranges of the species and better interpretation of relationships have been made possible.

The present report deals primarily with the specimens of amphibians and reptiles from Lower California now contained in the Museum of Vertebrate Zoology. For each species a set of concise statements comprises the following items of information: localities of capture; specimen numbers in the Museum collection; dates of collection. A summary of the habitat relations of the species is then given in so far as the collectors' field notes indicate them. Suitable comments are also offered in the case of forms where the material available has important new bearing on interpretation of the systematics in the group.

Numerous publications have dealt with the herpetological fauna of Lower California. They have been chiefly reports upon collections from that area, or general systematic revisions of genera; but two

works of special importance appeared in 1922. One of these, by Karl P. Schmidt, was based largely upon the collections of the Albatross Expedition of 1911, but it included also the result of this author's study of material in various museums in the eastern United States. The material now in the California Museum of Vertebrate Zoology fills many of the gaps pointed out by Schmidt, and in it both the middle and the northeastern parts of the peninsula are well represented by specimens. Both these areas were designated by Schmidt as meriting more field work in order properly to understand the general distribution of the amphibians and reptiles. He considered the chief defect of his review to be the "absence of complete and accurate data bearing on the habitat associations of the species concerned." Fortunately the collectors of the specimens now under consideration recorded the nature of the surroundings in which most of the individuals were found. This information, or a summary of it, has been added to the present accounts of species in the belief that it is of significance in establishing a better understanding of the relationships of the races.

Van Denburgh's (1922) work on The Reptiles of Western North America includes detailed description and synonymy, as well as accounts of the systematic status, life-history, and distribution for each species as then known. The Lower Californian species are considered in their proper relation to species in neighboring areas in western North America. Just as in Schmidt's case, Van Denburgh's work depended largely upon material from the Cape region and from the islands near the shore for its treatment of the whole area of Lower California.

The 89 species and subspecies considered in the present list are represented by 1674 specimens. The accumulation of this material is the result of the activities of the field collectors, chiefly Mr. Chester C. Lamb, who was a member of every expedition and the leader of most of them. Other persons who collected for the Museum on these trips are Mr. Adrey E. Borell, Mr. Raymond M. Gilmore, Mr. J. Elton Green, and Dr. Joseph Grinnell.

GAZETTEER OF LOCALITIES

This list includes the names of only those localities from which the Museum of Vertebrate Zoology has specimens of amphibians and reptiles. For most of them the name, general position on the peninsula, and latitude are given in accordance with the much more complete list given by Grinnell (1928, pp. 19–32). A few localities not included in Grinnell's list are annotated more fully and reference is made to some generally accessible map which shows them. In general the arrangement of localities under each species is from north to south; the arrangement in this gazetteer is, of course, alphabetical.

Agua Caliente: village in interior of Cape district about lat. 23° 30′. Brewster, 1902, map.

Agua Chiquita: camp four miles northeast of San Quintín, on Pacific coast, lat. 30° 30′. Am. Geog. Soc. "Norte" map.

Aguaje del Sauce: west of base of Sierra San Pedro Mártir, near lat. 30° 53′.

Almejas Bay: on mainland side of Santa Margarita Island, lat. 24° 25′. Nelson, 1921, p. 90, pl. 35.

Calamajué: toward eastern side of peninsula at about lat. 29° 40′.

Calmallí: interior at lat. 28° 15′.

Cataviña: ranch in interior, on Pacific drainage, at about lat. 29° 47′. Nelson, 1921, pl. 35.

Cedros Island: Pacific side, lat. 28° 10′.

Cerro Prieto: hill on western side of Colorado Delta, lat. 32° 25′.

Comondú: on Pacific slope at lat. 26° 5′.

Concepción: on western flank of Sierra San Pedro Mártir, near lat. 31° 7′.

Cornicabra: ranch on Pacific slope, lat. 25° 30′. Automobile Club of Southern California, 1930, map.

El Cajón Cañon: on east side of Sierra San Pedro Mártir, lat. a little south of 31°.

El Major: on western edge of Colorado Delta, about lat. 32° 5′.

El Medano: ranch on Pacific slope about even with Santa Margarita Island, lat. 24° 30′. Automobile Club of Southern California, 1930, map.

El Rosario: near Pacific seacoast, lat. 30° 3′.

El Sauz: in Sierra de La Laguna, Cape district, about lat. 23° 27′.

El Valle de La Trinidad: about lat. 31° 20′.

Espíritu Santo Island: in the Gulf, lat. 24° 30′.

Eureka: on eastern side of Cape district, about lat. 23° 25′.

La Ballena: ranch on Pacific coast, about lat. 24° 10′. Automobile Club of Southern California, 1930, map.

La Grulla: on the Sierra San Pedro Mártir, a little south of lat. 31°.

Laguna Hanson: on the Sierra Juárez, close to lat. 32°.

La Paz: on Gulf coast, lat. 24° 10′.

Las Cruces: about 20 miles east of Ensenada, about lat. 31° 52′.

Las Palmas Cañón: at east base of Sierra Juárez, about 25 miles south of United States boundary west of Mexicali.

Los Coronados Islands: Pacific side, lat. 32° 25′.

Los Dolores: ranch on Gulf coast, opposite north end of San José Island, lat. 25° 3′. Nelson, 1921, pl. 35.
Magdalena: port on east shore of Magdalena Island, lat. 24° 38′.
Medano Amarillo: a landing place for boats going to and from Magdalena Island, on shore of Magdalena Bay, about lat. 24°. Automobile Club of Southern California, 1930, map.
Miraflores: in the Cape district, about lat. 23° 24′.
Nachogüero Valley: at United States boundary, about between Jacumba and Campo.
Pilot Knob: southeastern Imperial County, Upper California.
Puerto Ballandra: on Gulf side, lat. 24° 19′.
Rufugio: ranch on Pacific slope opposite Santa Magdalena Island, about lat. 24° 45′. Automobile Club of Southern California, 1930, map.
Rosario River: camp, one mile east of El Rosario, village near the Pacific seacoast, lat. 30° 3′. Nelson, 1921, p. 24, pl. 35.
San Antonio Ranch: west base of San Pedro Mártir, near lat. 30° 50′.
San Felipe: on Gulf coast, lat. 31° 2′.
San Francisco Island: in the Gulf, lat. 24° 50′.
San Ignacio: on the interior western slope, lat. 27° 17′.
San Jorge: near Pacific seacoast, lat. 25° 44′.
San José: west base of Sierra San Pedro Mártir, about lat. 31°.
San José del Cabo: in the Cape district, lat. 23° 3′.
San José Island: in the Gulf, lat. 25°.
San Martín Island: Pacific side, lat. 30° 29′.
San Quintín: on Pacific coast, lat. 30° 29′.
San Ramón: on Pacific coast, lat. 30° 43′.
Santa Anita: in Cape district, about lat. 23° 10′.
San Telmo: village on Pacific slope close to lat. 31°.
Santo Domingo: near Pacific seacoast, about lat. 25° 30′.
Santo Domingo River: flowing west from Sierra San Pedro Mártir, about lat. 30° 45′.
Santo Tomás: village on Pacific drainage at about lat. 31° 35′.
San Vicente: on Pacific drainage at about lat. 31° 20′.
Socorro: collecting station at a well and deserted house, about 20 miles south of San Quintín, on Pacific coast, about lat. 30° 20′. Nelson, 1921, pl. 35.
Todos Santos: on Pacific coast of Cape district, lat. 23° 27′.
Todos Santos Island: Pacific side, lat. 31° 48′.
Triunfo: in the Cape district, about lat. 23° 50′.
Valladares: west base of Sierra San Pedro Mártir, about lat. 30° 52′.
Vallecitos: Sierra San Pedro Mártir, near lat. 31°.
Yrais: camp on edge of Llano de Yrais, a plain on east side of Magdalena Bay, lat. 24° 40′. Nelson, 1921, p. 41, pls. 14, 35. [Spelled "Hiray" on collector's labels.]

Check list of amphibians and reptiles in the Museum of Vertebrate Zoology from Lower California, with number of specimens of each form:

Scaphiopus couchii Baird, 3.
Scaphiopus hammondii Baird, 1.
Bufo boreas halophilus Baird and Girard, 24.
Bufo cognatus Say, 2.

Bufo californicus Camp, 5.
Bufo punctatus Baird and Girard, 50.
Bufo woodhousii Girard, 2.
Hyla arenicolor Cope, 19.
Hyla regilla Baird and Girard, 37.
Rana aurora draytonii Baird and Girard, 26.
Rana pipiens Schreber, 4.
Phyllodactylus tuberculosus Wiegmann, 1.
Phyllodactylus unctus (Cope), 2.
Coleonyx variegatus (Baird), 1.
Ctenosaura hemilopha Cope, 20.
Dipso-saurus dorsalis dorsalis (Baird and Girard), 20.
Dipso-saurus dorsalis lucasensis Van Denburgh, 36.
Crotaphytus collaris baileyi Stejneger, 2.
Crotaphytus wislizenii Baird and Girard, 3.
Sauromalus ater Duméril, 1.
Callisaurus draconoides draconoides Blainville, 16.
Callisaurus draconoides carmenensis Dickerson, 122.
Callisaurus draconoides gabbii Cope, 37.
Uta thalassina Cope, 7.
Uta repens Van Denburgh, 16.
Uta mearnsi Stejneger, 3.
Uta ornata symmetrica Baird, 5.
Uta graciosa (Hallowell), 1.
Uta nigricauda Cope, 151.
Uta microscutata Van Denburgh, 118.
Uta stansburiana Baird and Girard, 222.
Uta concinna Dickerson, 11.
Uta martinensis Van Denburgh, 20.
Sceloporus graciosus vandenburgianus Cope, 27.
Sceloporus occidentalis bi-seriatus Hallowell, 25.
Sceloporus magister magister Hallowell, 4.
Sceloporus magister rufidorsum Yarrow, 68.
Sceloporus magister zosteromus Cope, 22.
Sceloporus orcutti Stejneger, 29.
Sceloporus licki Van Denburgh, 11.
Phrynosoma coronatum coronatum (Blainville), 43.
Phrynosoma coronatum blainvillii Gray, 6.
Phrynosoma coronatum jamesi Schmidt, 9.
Phrynosoma platyrhinos Girard, 1.
Gerrhonotus multi-carinatus (Blainville), 4.
Gerrhonotus scincicauda webbii Baird, 22.
Anniella pulchra Gray, 4.
Cnemidophorus maximus Cope, 12.
Cnemidophorus tesselatus tesselatus (Say), 53.
Cnemidophorus tesselatus rubidus Cope, 8.
Cnemidophorus hyperythrus schmidti (Van Denburgh and Slevin), 62.
Cnemidophorus hyperythrus hyperythrus (Cope), 71.
Eumeces skiltonianus skiltonianus (Baird and Girard), 6.
Eumeces skiltonianus lagunensis Van Denburgh, 1.
Bipes biporus (Cope), 2.
Leptotyphlops humilis humilis (Baird and Girard), 2.

Leptotyphlops humilis slevini Klauber, 2.
Lichanura roseofusca roseofusca Cope, 1.
Lichanura trivirgata Cope, 3.
Masticophis piceus (Cope), 2.
Masticophis flagellum frenatus (Stejneger), 7.
Masticophis lateralis (Hallowell), 2.
Salvadora grahamiae hexalepis (Cope), 4.
Phyllorhynchus decurtatus (Cope), 1.
Elaphe rosaliae (Mocquard), 2.
Arizona elegans occidentalis Blanchard, 1.
Pituophis catenifer annectens Baird and Girard, 9.
Pituophis catenifer deserticola Stejneger, 1.
Pituophis vertebralis (Blainville), 8.
Lampropeltis getulus conjuncta Cope, 4.
Lampropeltis getulus yumensis Blanchard, 4.
Lampropeltis californiae nitida Van Denburgh, 2.
Lampropeltis zonata (Lockington), 1.
Sonora episcopa (Kennicott), 4.
Hypsiglena ochrorhynchus Cope, 4.
Natrix valida (Kennicott), 5.
Thamnophis ordinoides hueyi Van Denburgh and Slevin, 1.
Thamnophis ordinoides hammondii (Kennicott), 28.
Chilomeniscus stramineus Cope, 51.
Chilomeniscus cinctus Cope, 7.
Trimorphodon lyrophanes (Cope), 2.
Crotalus atrox Baird and Girard, 2.
Crotalus cerastes Hallowell, 5.
Crotalus enyo (Cope), 6.
Crotalus lucasensis Van Denburgh, 8.
Crotalus confluentus mitchellii (Cope), 4.
Crotalus confluentus oreganus Holbrook, 3.
Crotalus ruber (Cope), 7.
Clemmys marmorata (Baird and Girard), 3.

Scaphiopus couchii Baird

Eureka: 11435–36; August 16, 1929.
San José del Cabo: 8293; September, 1893.

Both the specimens from Eureka were caught in deep water in an irrigation ditch. Several individuals of *Bufo punctatus* were captured at the same time and place.

Scaphiopus hammondii Baird

San José, latitude 31°: 9828; May 7, 1925.

The specimen recorded here was caught at dusk at the edge of a sandy flat near a creek at 2500 feet altitude.

Capture at San José extends the range of this species a little more than fifty miles southward from Ensenada, the only other known locality of occurrence in Lower California (Schmidt, 1922, p. 663). Both these localities are on the Pacific drainage side of the peninsula.

Bufo boreas halophilus Baird and Girard

North end of Nachogüero Valley: 10688–99; November 15, 1927.

Vallecitos, 8000 feet, San Pedro Mártir Mountains: 9864–65, 9869; June 9 and 10, 1925.

La Grulla, 7500 feet, San Pedro Mártir Mountains: 9858–63, 9866–68; May 17–25, 1925.

In the Nachogüero Valley the toads were in a shallow well six feet below the surface. They were small and were captured with the aid of a water bucket. At Vallecitos toads were caught at night among pine trees on a sandy hill and in a damp place in a creek bottom. At La Grulla some specimens were found among rocks and others in the dry sand near a creek; all were taken after dark.

Bufo cognatus Say

Colorado River, twenty miles south of Pilot Knob: 10730; October 12, 1927.

Seven miles east of Cerro Prieto: 10752; May 26, 1928.

The first listed specimen was picked up at dusk as it hopped on the ground. The second was found, also at dusk, on the ground among bee hives. These records extend the known range of this toad southward into the delta region of the Colorado River in Lower California.

Bufo californicus Camp

Valladares, 2700 feet altitude: 9853, 9855; April 20, 1925.

San Antonio Ranch, San Antonio Creek, 2100 feet altitude: 9854, 9856–57; April 25, 1925.

These specimens were obtained at night among dry leaves beneath willows near a creek, among dry sycamore leaves, and in a garden near a creek.

Two size-groups are represented in this lot of specimens. The two from Valladares measure approximately 65 mm. in length. The three individuals from San Antonio Ranch measure 35, 40, and 45 mm. in length. Compared with the type these specimens agree in all essentials of structure and color except that they are darker than the type and the markings are more sharply defined on the specimens in the smaller size-group. The two large individuals are almost exactly the same size as the type. The paratoid glands in the Lower Californian specimens are slightly (about 1 mm.) narrower than in the type.

Bufo punctatus Baird and Girard

Las Palmas Cañón: 10700–01; November 1 and 3, 1927.
El Cajón Cañon: 9568–71; May 15, 1926.
Cataviña: 13110–17; March 21 and 23, 1931.
Fifteen miles north of San Ignacio: 13118; March 27, 1931.
San Ignacio: 10628; May 5, 1927.
Miraflores: 11437–39, 11460–61; November 15 and 16, 1928.
Santa Anita: 11440; April 25, 1929.
Eureka: 11450–59; August 16, 22, and 25, 1929.
Agua Caliente: 11441–49; May 30 and June 2, 3, 4, 5, 9, and 13, 1929.
Santo Domingo, latitude 25° 30′: 13119–22; May 5 and 6, 1931.
San José del Cabo: 8294–97; September, 1894.

At Cataviña, 1850 feet altitude, on March 21, 1931, a series of seven toads was caught by hand in a stream at night. On March 23 one was found at night on the ground close to the river bed. On March 27 a single toad was found beneath a rock at the edge of a dry arroyo, fifteen miles north of San Ignacio. The four specimens taken on May 5 and 6 at Santo Domingo were on the ground at night; two were caught in mouse traps set beside bushes in sandy soil close by an arroyo. Two individuals from Eureka were captured, August 16, 1929, in a deep place in an irrigation ditch. Another was caught swimming in a ditch near Santa Anita on April 25, 1929. At Las Palmas Cañón on November 3, 1927, one of these toads was found in a pan of water in a tent. Another one at the same locality was found hopping on the ground at night.

Bufo woodhousii Girard

Colorado River at latitude 32° 15′: 10702–03; March 2, 1928.

One of these toads was caught among tules; the other was found on the bare ground near a tent at 7 o'clock in the evening. Although this species has not been collected and reported previously from Lower California, it has been recorded from points on the Colorado River only a few miles north of the United States boundary.

Hyla arenicolor Cope

El Cajón Cañon: 9572–82; May 19, 20, 21, 26 and June 3, 1926.
San José, 2500 feet altitude, about 31°: 9840; May 4, 1925.
Las Palmas Cañón, 200 feet altitude: 10704–05; November 4, 1927.
Valladares, 2700 feet altitude: 9843–44; April 18 and 20, 1925.
San Antonio Ranch, 2100 feet altitude: 9829, 9841–42; April 24 and 27, 1925.

The two specimens from Las Palmas Cañón were caught in a small pool of running water, three feet in diameter, set between rocks, and covered with young fan palms. There were three tadpoles in the same pool. The other individuals were captured near creeks, some among dry leaves beneath willows, some on the creek bank, and others on granite boulders or large flat stones at the margin of a stream.

Hyla regilla Baird and Girard

El Valle de La Trinidad: 10682; November 21, 1926.

San Telmo: 9879–80, 9896; March 28, April 3, and November 30, 1925.

Vallecitos, near 8500 feet altitude: 9850–52; June 11, 1925.

La Grulla, 7200 feet altitude: 9845–46, 9848–49, 10498; May 16, 18 and 19, and October 2, 1925.

San Ramón: 9847, 9876–78; March 18 and 23 and April 27, 1925.

Cataviña: 13123–27; January 15, 16, and 22, 1931.

Cedros Island: 9707–11; July 23 and 24, 1925.

San Ignacio: 10629; April 23, 1927.

El Sauz, Victoria Mountains: 11462–67; November 11, 12, 26, 27, and 30, 1928.

Agua Caliente: 11468–70; May 30, 1929.

Places of capture of this species ranged from near sea level up to about 8500 feet. The kinds of habitat where individuals were taken were characterized by the collectors as follows: in dry grass above creek, among rocks at streamside, under log in damp place by creek, at border of a water hole, hopping across a damp ditch, in pool in creek, in water among rocks at edge of creek, in cement tank of water, in water bucket in well. In every instance the animal was either in the water or in some situation only a few feet distant from water. The general desert conditions which prevail at the localities of capture probably tend to keep this species closer to water in Lower California than is the case in some parts of its range farther to the north. At Cataviña specimens taken in January were found in a well and at a spring. At this place the tree toads were discovered at night by the aid of a flashlight.

Rana aurora draytonii Baird and Girard

San José, 2500 feet altitude: 9663–64, 9837; May 4 and October 20 and 21, 1925.

La Grulla: 9820–27, 9838–39; May 14–22, 1925.

Valladares: 9830–34; April 14, 15 and 20, 1925.

San Antonio Ranch, 2100 feet, Santo Domingo River: 9835–36; April 21 and 24, 1925.

San Ramón, mouth of Santo Domingo River: 9870–75; March 16, 18 and 22, 1925.

More than half the specimens in the series listed above were captured in or at the margins of streams. One individual was taken from a spring, one from a slough, one from the ground beneath willows near a creek, two in rat traps at the edge of a swamp, three from a marsh, and four from a lake. One of the frogs was captured by the use of a trout fly.

Rana pipiens Schreber

Colorado River, twenty miles south of Pilot Knob: 10731–33; October 16, 17 and 22, 1927.
Colorado River at 32° 15′ latitude: 10706; March 1, 1928.

Two of the specimens were caught in rat traps set among tules. One was found hopping on the ground at a damp spot among the willows.

The localities here recorded are the first ones for this frog in Lower California. They provide extensions of the previously known range of the species, down the Colorado River.

Phyllodactylus tuberculosus Wiegmann

Puerto de Calamajué: 13128; January 31, 1931.

This lizard was captured at night near an old wall. As the animal started for a crack in the wall the collector grabbed for it. As he did so the tail came off.

Phyllodactylus unctus (Cope)

La Paz: 11472; March 16, 1929.
Miraflores: 11471; November 15, 1928.

Coleonyx variegatus (Baird)

San Felipe: 9547; April 2, 1926.

The single individual was taken at night by aid of a lantern, as it crawled in the salt grass.

This specimen is normal for the species in structure but differs somewhat from the average, as represented in the Museum of Vertebrate Zoology, in pattern of coloration. Instead of having broad dark bands crossing the body it has narrow and irregularly broken bands with many scattered small spots. The light areas on the body are much more extensive than the dark areas.

Ctenosaura hemilopha Cope

Five miles south of La Paz: 11487; February 7, 1929.
Eureka: 11489–90; August 22, 1929.
Todos Santos: 11473–83; October 13 to 31, 1928.
Agua Caliente: 11488, 11513–14; June 1, 11, and 17, 1929.
Miraflores: 11484–86; November 15 and 16, 1928.

Two specimens of this series of lizards were shot from limbs of large trees—one was on the topmost limb. Another one was found on a rocky ledge of a low cliff at the edge of a valley.

Seven young, varying in body length from 67 to 95 mm., were taken on dates as follows: October 29 and 31, November 15 and 16, 1928; February 7, 1929.

Dipso-saurus dorsalis dorsalis Baird and Girard

Thirteen miles northwest of El Major: 9518; April 29, 1926.

San Felipe: 9514–17; March 25, 28, and 31, 1926.

El Cajón Cañon: 9583; May 20, 1926.

San Ignacio: 10630–31 and 13138–49; April 29, 1927, July 25 and 27, and August 2, 1931.

The single specimen from near El Major was shot in a clump of creosote bushes on gravelly ground. Four specimens were obtained at San Felipe in situations as follows: one was shot at the margin of a clump of bushes; one was caught in a rat trap set near bushes and another in a gopher trap set in a supposed gopher hole; the fourth was killed on the sand in a sandy draw. At El Cajón Cañon a crested lizard was shot on the desert at the mouth of a cañon. At San Ignacio one specimen was found at the end of April, under a low bush on the desert.

Fourteen of the twenty specimens listed above are from San Ignacio, near the center of the peninsula. In this lot of fourteen individuals one has a single scale between the rostral and nasal and all the others have double rows of scales in this position. It is thus definitely established that the population of central Lower California belongs with the northern race with respect to this structural character. In coloration the specimens from San Ignacio are more like those from the Cape region than the ones from farther north. They do not possess the well defined longitudinal dark lines on the sides, a character that most of the available northern specimens show in contrast with the pattern shown by specimens from the Cape region. The specimens from the southernmost locality listed above show evidence, therefore, of intergradation with the race in the Cape district. The chief area of intergradation, however, must be in the region to the southward from San Ignacio.

Dipso-saurus dorsalis lucasensis Van Denburgh

Almejas Bay Santa Margarita Island: 13132; June 14, 1931.

El Medano: 13129–31; May 26, 1931.

Triunfo, 1400 feet altitude: 13133–37; June 20 and 22, 1931.

Todos Santos: 11519; October 14, 1928.

Eureka: 11497–511, 11520; August 22 and 23, 1929.

Agua Caliente: 11515–18; June 5, 6, 7, and 9, 1929.

Santa Anita: 11491–96; April 25 and 26, 1929.

The specimen from Santa Margarita Island was collected on a sparsely covered bushy hillside. At El Medano three individuals were shot among light brush in an arroyo. Two of the specimens from Agua Caliente were found on the ground among cactus plants. Another one was on a bare area in brushy ground.

Seven young individuals taken August 22, 1929, at Eureka measured between 45 and 65 mm. in length from snout to anus. A young one captured at Todos Santos, October 14, 1928, measured 62 mm. from snout to anus. Total length of this individual was 182 mm.

The race *lucasensis* was described by Van Denburgh (1920, p. 33) on the basis of the separation of the rostral from the nasal by but one granular scale. In the typical subspecies (*dorsalis*) the rostral is usually separated from the nasal plate by two rows of granules. All the specimens from the localities listed above, except Triunfo and Todos Santos, agree uniformly with the original diagnosis of the southern race. From Triunfo one specimen has a single scale between the rostral and nasal, another has a single scale on one side and two rows on the other side, and three specimens have a double row of scales. The single individual from Todos Santos has two rows of scales separating the frontal from the nasal. Evidently the population in the Cape district constitutes a race distinguished from the northern representative by characters of both color and scalation, but more markedly by the latter.

Crotaphytus collaris baileyi Stejneger

Las Palmas Cañón: 10707; November 3, 1927.
El Cajón Cañon: 9590; May 31, 1926.

The two individuals listed above were clinging to rocks when shot; one was near a small stream in a main cañon. Both specimens have two longitudinal rows of shields separating the supraocular regions.

Measurements of the two specimens listed above are as follows:

Number	9590	10707
Sex	♂	♂
Length to anus	100 mm.	107 mm.
Length of tail	236 mm.	220 mm.
Snout to orbit	14 mm.	14 mm.
Snout to ear	32 mm.	28 mm.
Width of head	27 mm.	22 mm.
Fore limb	35 mm.	46 mm.
Hind limb	108 mm.	92 mm.
Base of fifth to end of fourth toe	34 mm.	36 mm.
Interorbital scales	2 rows	2 rows
Femoral pores	R. 19—L. 21	R. 21—L. 20

The trinomial is applied here to this form mainly on the basis of the facts given by Burt (1929). These seem to me to show conclusively that this species is best considered as divisible into two satisfactorily recognizable geographic races with characters and ranges as have been commonly recognized by previous authors.

One of the specimens, number 10707, as it is now preserved shows the pouch-like throat fan already reported for this species by Burt (1931*b*, p. 58).

Crotaphytus wislizenii Baird and Girard

El Cajón Cañon: 9589; May 29, 1926.
El Medano, 50 feet altitude: 13150–51, May 18, 1931.

The specimen listed first above was shot in sand in a trail. The two individuals from El Medano were shot in open spaces among mesquites. These three specimens are insufficient to afford much help in clearing up the uncertainty regarding the status of this variable species on the peninsula of Lower California.

Sauromalus ater Duméril

San Francisco Island: 11512; March 8, 1929.

The single individual collected was found beneath a rock on a hillside. It is not fully grown, but in characters of scalation it agrees with specimens from La Paz and Espíritu Santo Island as they have been described by Van Denburgh (1922, p. 95) and Schmidt (1922, p. 640). Measurements are as follows: total length, 176 mm.; length to anus, 85 mm.; length of tail, 93 mm. Ventral scales, 135 rows between gular fold and anus. Scales in caudal whorl at largest part of the tail, 63. I have been able to detect no peculiarities of this insular individual when contrasted with the descriptions of other specimens of this species.

Callisaurus draconoides draconoides Blainville

Espíritu Santo Island: 11525; January 20, 1929.
Triunfo, 1400 feet altitude: 13273–74; June 23 and 24, 1931.
Eureka: 11539–42; August 22, 1929.
Agua Caliente: 11538; June 25, 1929.
Todos Santos: 11521–24; October 14, 17, and 18, November 6, 1928.
San José del Cabo: 11534–37; April 2, 5 and 10, 1929.

The sixteen specimens of gridiron-tailed lizard listed above from the Cape region of Lower California confirm the definition of the race *C. d. draconoides* as given by Van Denburgh (1922). The chief distinguishing characters ascribed to this subspecies and exhibited in the series now available are as follows: The males have two nearly vertical lateral black blotches followed by a third black spot. The dorsal caudal bars are never black. They usually have strongly undulate or pointed posterior margins. In coloring of the back and tail this race is like *C. d. carmenensis*.

This series fully corroborates the treatment of this race given by Van Denburgh.

Callisaurus draconoides carmenensis Dickerson

Calmallí: 13165; March 27, 1931.

San Ignacio, lat. 27° 17′: 10632–37, 13214–272; April 9 to 28, 1927, March 29, July 25 to 31, August 1 and 2, 1931.

Comondú: 13166; April 10, 1931.

Santo Domingo, lat. 25° 30′, 100 feet altitude: 13167–72; May 4, 1931.

Almejas Bay, Santa Margarita Island: 13176–213; June 6 to 14, 1931.

El Medano, 50 feet altitude: 13173–74; May 17, 1931.

La Ballena: 13175; May 20, 1931.

Los Dolores: 11528–33; March 12, 1929.

San José Island: 11526–27; February 26 and March 9, 1929.

At six of the localities where this species was captured, it was found on sandy soil. The situations inhabited included a sandy bank, sand dunes back from a beach, sandy flat back from a beach, among low bushes on a sandy area, gravelly soil on a mesa, on sparsely covered brushy hillside, sandy soil of an arroyo.

The chief characters which distinguish the present race from closely adjacent ones are exhibited by the specimens listed above as follows: Males are distinguished from *C. d. draconoides* in having two large oblique lateral black blotches usually not followed by a third black spot. From the race *C. d. gabbii* the present lot of specimens is separated by having the dark dorsal bars on the tail with strongly undulate or pointed posterior margins from base to beyond the middle of the tail, and in having the dorsal tail bars dark brown, never black.

The form *crinitus*, known from specimens representing localities on the central-western coast of Lower California, is distinguished by having the digits with a lateral fringe of long spinose scales and by the possession of three oblique lateral black bars. Certain specimens from San Ignacio show tendencies to vary toward these characters, thus indicating a close relationship between *carmenensis* and *crinitus*. It is expected that further material would demonstrate that *crinitus* is a subspecies of *C. draconoides* closely related to the race *carmenensis*.

The two specimens from San José Island have relatively longer forelegs than any individuals from the mainland of the peninsula. The legs, when folded against the body extend entirely across the femora. In other individuals they do not quite reach the anterior margins of the femora.

Callisaurus draconoides gabbii Cope

Colorado River, twenty miles south of Pilot Knob: 10708–09; October 7, 1927.

Thirteen miles northeast of El Major: 9531; April 29, 1926.

San Felipe: 9519–30; March 30 to April 16, 1926.

El Cajón Cañon: 9584–85; May 16 and 20, 1926.

San José, west base of Sierra San Pedro Mártir, 2500 feet altitude: 9712–17; May 7, 1925.

Calamajué Valley, 500 feet altitude: 13275; February 3, 1931.

Cataviña: 13152–64; March 18 to 23, 1931.

Practically all the specimens listed above were obtained from sandy ground. Some were on open desert, but many were taken on sandy hills or in cañons. At many of the situations there were piles of old lumber, rocks, or clumps of brush and weeds which might serve as cover for the lizards. One individual was obtained on a gravel fan at the base of a mountain.

The area represented by the specimens listed above has been included in the ranges of different subspecies by different writers within recent years. The material available in the present collection shows a still different treatment to be needed. Van Denburgh (1922, p. 148) recognized the distinction between the present form and the race to the south which he called *C. d. carmenensis.* The specimens from northern Lower California, however, he placed along with the Arizona race "*C. v. ventralis.*" Schmidt (1922) did not recognize the race *carmenensis,* but he separated the northern Lower California specimens from the Arizona specimens and revived the name *gabbii* for the former race. The specimens now available indicate that these two workers were right in recognizing one of the limits of the range of *gabbii* but that each overlooked the opposite limit. Omitting consideration of the form *crinitus* whose status is not satisfactorily known, the available facts seem to indicate that the group of forms of *Callisaurus* on the peninsula of Lower California and in western United States constitutes one species and this species would take the name *draconoides,* which was the first bestowed in the group. The range of characters separating any two of the subspecies is not large but in each case there is good evidence of intergradation where the ranges meet.

Callisaurus draconoides gabbii exhibits characters as follows: Males have two large oblique lateral black blotches not followed by a third black spot; dark dorsal tail bars with nearly straight or slightly undulate posterior margins at least from middle to end of tail; dorsal tail bars black in males; occipital and supraorbital semicircles usually separated by a row of scales (reverse of condition in *C. d. ventralis*); ratio of tail length to total length greater than in *C. d. ventralis;* ratio of length of hind leg to body length greater than in *C. d. ventralis;* femoral pores average less than 17 (17 or more is average in *C. d. ventralis*).

Uta thalassina Cope

El Sauz, Victoria Mountains: 11543–47; December 1 to 13, 1928.

Agua Caliente: 11548–49; June 1 and 5, 1929.

Six of the seven specimens obtained of this species were shot from rocks. The rocks were both in stream beds and on hillsides. The seventh specimen was shot from the wall of an old palm hut. The places of capture represent altitudes ranging from 800 feet up to 5700 feet.

Uta repens Van Denburgh

Cataviña: 13276–84; March 18 to 23, 1931.
Comondú: 13285–91; April 1 to 20, 1931.

Sixteen specimens in the Museum of Vertebrate Zoology represent this species. Hitherto nothing has been known about the habitat relations of this particular lizard. The following notes recorded by the collector serve to give some notion of the type of ground inhabited. At Cataviña rocky ground furnished the favored kind of surroundings. Four individuals were shot from the tops of rocks—one was on the top of a fence post, two were among the rocks of a cañon side, and one was shot beside a low bush. Similarly at Comondú five specimens were taken as they clung to rocks on a cañon side. At this place two specimens were brought in by a boy.

TABLE 1

MEASUREMENTS OF *Uta repens* AND *Uta thalassina*

(In millimeters)

No.	Locality	Length to anus	Snout to fold	Snout to orbit	Snout to ear	Snout to back of interparietal	Width of head	Fore limb	Hind limb	Base 5th to end 4th toe
					Uta repens					
13280	Cataviña....	141	45.5	14	30.7	18 4	29.4	61.5	81	27.4
13288	Comondú......	113	39.3	12.7	27.5	13.4	24.7	49 6	64	22.8
13289	Comondú....	102	33	11.3	23.9	14	19.6	38 6	60	18
13290	Comondú...	102	33	11 2	22.6	14.8	20	36	58	18.8
13285	Comondú.....	98	30	11.7	22	13.0	18.4	42	60	17.7
					Uta thalassina					
11546	El Sauz..........	140	49	17	34	19	27	52	85	29

The species *Uta repens* was described by Van Denburgh (1895, p. 102) on the basis of a single specimen from Comondú. In a later work (1922, p. 191) that worker assigned four specimens to this species, representing three additional localities: Mulege, San Xavier, and Danzante Island. Schmidt (1922, p. 653) on the basis of the original description and his examination of a series of ten specimens of *Uta thalassina* concluded that *Uta repens* did not warrant recognition as a form distinct from *U. thalassina*. The original diagnosis characterized this species as "allied to *Uta thalassina*, but with hind limb much shorter, snout shorter and more truncate, and four transverse black dorsal bars in place of the anterior three of that species."

Careful comparison of the series of sixteen specimens, seven of them from the type locality, with the seven available specimens of

thalassina demonstrates that the characters pointed out as distinguishing these forms hold with remarkable uniformity. While there is a general similarity in appearance between the two lots of specimens, they are sufficiently distinct to suggest strongly that the forms are related specifically and not subspecifically. Additional material from intervening localities might, however, bridge the gap in structural characters shown by the present material.

Uta mearnsi Stejneger

El Cajón Cañon: 9591–92; May 16 and June 4, 1926.

Fifteen miles northwest of Mission Calamajué, 1600 feet altitude: 13848; January 30, 1931.

One of the specimens taken was running over granite boulders, another was found on the face of a cliff in a cañon. The very small young individual, taken on January 30, was found in an old tin can.

Uta ornata symmetrica Baird

Colorado River, twenty miles south of Pilot Knob: 10717, 10720–21; October 11 and 17, 1927.

Seven miles east of Cerro Prieto: 10753–54; May 26 and June 6, 1928.

Two of the specimens listed above were caught in a large dry tank. The two from near Cerro Prieto were obtained from the trunks of willow trees. Occurrence of this lizard in Lower California has been reported previously from only one locality, the Cocopah Mountains (Schmidt, 1922, p. 659).

Uta graciosa (Hallowell)

San Felipe: 9532; March 22, 1926.

The single specimen listed above was caught beneath a mesquite tree.

Uta nigricauda Cope

La Paz: 11657; February 21, 1929.

Triunfo: 13502–54; June 19 and 20, 1931.

Eureka: 11660–87; August 16, 21, 22 and 26, 1929.

Todos Santos: 11604–29; October 14 and 15, 1928.

Agua Caliente: 11694–700; June 2 to 19, 1929.

Miraflores: 11630–42, 13557–58; November 15, 1928; June 26, 1931.

El Sauz: 11643–56; November 21 and 23, and December 11, 12 and 13, 1928.

Santa Anita: 11659; April 25, 1929.

San José del Cabo: 8298–301, 11658, 11693; March, 1892, and April 4, and 30, 1929.

Most of the specimens listed above were brought to the collector by native Mexican boys. Of the nineteen individuals captured sixteen were on rails of old corrals, one was on the trunk of an avocado tree, one was on the trunk of a grapevine, and one was on a sack of cotton in the camp. Not one was on the ground.

Uta microscutata Van Denburgh

San José, latitude 31°: 9722–23; May 7, 1925.
El Cajón Cañon: 9610–14, 9616, 9619–21, 9623–28; May 4 to June 2, 1926.
Socorro: 13351–54; February 28 and March 1, 1931.
Cataviña: 13362, 13366–67, 13371, 13374–75; March 20, 21 and 23, 1931.
San Ignacio: 10641–49, 13378–91; April 9, 18, 23 and 25, 1927, March 27 and 29 and July 25 to 29, 1931.
Comondú: 13392–55; March 29, and April 1, 2, 8, 9, 16 and 18, 1931.
El Medano: 13474–75; May 17, 1931.
Medano Amarillo: 13476; May 27, 1931.
Magdalena, Santa Magdalena Island: 13486; May 31, 1931.

Specimens of *Uta microscutata* came from several localities and from the following situations: San José: two on side of an old adobe house. El Cajón Cañon: five on limbs or trunks of mesquite trees, four on rocks, two drowned in water buckets, one on sand close to stream, one in mouse trap set among rocks. Socorro: in tent, in mouse trap, in open space among weeds, on top of a rock. Cataviña: on rock ledge at cañon side, among rocks, on top of a rock, on trunk of a mesquite, on limb of a mesquite, one on March 20, in semi-dormant condition on wet sand of river bed. Comondú: two shot from rocks at cañon side. El Medano: two on sandy soil in arroyo. Medano Amarillo: at edge of brush in sand dunes. Magdalena: on plateau among bushes.

Uta stansburiana Baird and Girard

North end of Nachogüero Valley, 3400 feet altitude: 10710–12; November 17, 18, and 27, 1927.
Colorado River, twenty miles south of Pilot Knob: 10718–19, 10722; October 17 and 23, 1927.
Colorado River, latitude 32° 15′: 10723; March 6, 1923.
Las Palmas Cañón: 10713–16; November 5, 6, 7 and 8, 1927.
Thirteen miles north of El Major: 9559–61; April 25, 26 and 29, 1926.
Todos Santos Island: 10481; January 14, 1927.
Las Cruces, twenty miles east of Ensenada: 10480; January 3, 1927.
Concepción: 9894–95; November 17 and 20, 1925.
San José, latitude 31°: 9656–61, 9718–21; May 6, September 29 and October 22 and 25, 1925.
Aguaje del Sauce: 9726; May 1, 1925.
San Felipe: 9533–43; March 28 to April 15, 1926.
Valladares: 9724; April 15, 1925.
El Cajón Cañon: 9615, 9617–18, 9622; May 17, 26 and 31, 1926.
San Antonio Ranch, 2100 feet altitude, San Antonio River: 9718, 9725; April 25, and 27, 1925.
San Ramón: 9881–84; March 18, 21 and 23, 1925.
El Rosario: 13292–94; December 21, 1930.
San Fernando: 13555; December 30, 1930.
Cataviña: 13355–61, 13363–65, 13368–70, 13372–73, 13376–77, 13556; March 18, 19, 20, 21 and 23, 1931.
Puerto de Calamajué: 13295–96; January 31, 1931.

San Ignacio: 10638–40, 13297–350; April 9 and 26, 1927, July 25 to 30, 1931.

Comondú: 13456–62; April 2, 16 and 18, 1931.

San Jorge: 13463–72; April 24, 25, 28 and 29, 1931.

Almejas Bay, Santa Margarita Island: 13489–13501; June 6 to 14, 1931.

El Medano: 13473; May 17, 1931.

Medano Amarillo: 13477; May 27, 1931.

Magdalena, Santa Magdalena Island: 13478–85, 13487–88; May 28, 30 and 31, 1931.

Los Dolores: 11691; March 12, 1929.

San José Island: 11563, 11690; February 26 and 28, 1929.

San Francisco Island: 11564–67; March 8, 1929.

Espíritu Santo Island: 11557–58; January 15 and 17, 1929.

Puerto Ballandra: 11559; January 24, 1929.

La Paz: 11560–62, 11689, 11692; December 30, 1928, January 31 and February 18, 1929.

Eureka: 11569–603; August 16, 22, 26 and 27, 1929.

Todos Santos: 11550–56, 11688; October 14 and 15, 1928.

Santa Anita: 11568; April 25, 1929.

The following brief notes on habitat occurrence, arranged by locality, indicate to some extent the choice for surroundings exhibited by this species. In Nachogüero Valley, Utas were obtained on large granite boulders and in a "cook tent." Colorado River: in and around camp, on sandy soil; resting on an old plank; on a pile of dead willows. Near El Major: on a rock in wash; in rocky, gravelly draw; in draw on rocky ground under creosote bush. Todos Santos Island: caught under a rock. Las Cruces: in mouse trap set among rocks on a hillside. Concepción: among rocks on dry hillside; on a small rock on a hillside. San José: under rock; four from under one piece of old tin on a sandy bottom; in sand among sage brush. Aguaje del Sauce: in dry sandy wash. San Felipe: among some dry weeds, at edge of a frutia bush; in tent; running through brush on sandy flat near beach; on gravel fan at base of mountains; on open desert; in sandy draw; under creosote bush in open desert. Valladares: in sandy wash. El Cajón Cañon: in mouse trap among rocks; on rock in cañon bottom; among willow twigs and sand in mesquite thicket. San Antonio Ranch: on rock on sandy flat; on a dead limb. San Ramón: under brush on dry sandy plain; under bush on sandy bank. El Rosario: three dug out of ground by boy on December 21. Puerto de Calamajué: feeding on bare space in front of old building; caught by hand under a mouse trap set in sand hills. Los Dolores: about a pile of mesquite wood. San José Island: beside a small bush. San Francisco Island: among low brush on sand hills just above beach. Espíritu Santo Island: standing under bush; caught by hand in early morning in sand. Puerto Ballandra: caught after it ran under a rock. La Paz: found in empty tin can; on sand dunes at beach.

Because of the great amount of individual and geographic variation in this species and the difficulty of properly evaluating the characters, it has been considered inadvisable to attempt to work out the status of each form in Lower California. This work, it seems, could be done more profitably in connection with a systematic revision of the whole genus.

Uta concinna Dickerson

Cedros Island: 9685–90, 13849–53; July 22 to 27, 1925, November 15, 16, 18 and 19, 1930.

Specimens of *Uta* captured on Cedros Island were found among rocks on flat ground and in a cañon, on the gravelly bed of an arroyo, and on the gravelly face of a cliff by the sea. The justification of giving a separate name to this form may be questioned, but the present series proves to be too small to give an adequate basis for judgment. This is especially true because the nature of variation in the mainland species, *Uta stansburiana* (its closest relative) is so little understood.

Uta martinensis Van Denburgh

San Martín Island: 9665–84; July 7 to 18, 1925.

The various types of situation in which individuals of this lizard were captured were characterized by the collector as follows: in the sand dunes back from the beach, in the sandy flat back of the dunes, in a bare space among lava, under a bush on the sandy flat, among some ice plant near the beach.

The series of twenty specimens listed above from San Martín Island conforms with the description of *Uta martinensis* as given by Van Denburgh (1922, p. 247). In coloration this lot of specimens appears to average darker than any mainland race of the *stansburiana* group. The extent of blue on the lower surfaces seems to be greater than in *stansburiana*. With respect to size the ten largest (adults) of the twenty individuals range in length from snout to anus from 56.9 mm. to 61.8, averaging 58.9. In other words this island-inhabiting lizard is at least 20 per cent larger than its nearest related species on the mainland.

Sceloporus graciosus vandenburgianus Cope

Vallecitos, 8000 feet altitude: 9609, 9759–62; June 7, 8, and 10, 1925, and June 17, 1926.

La Grulla, 7200 feet altitude: 9749–57, 9763–75; May 11 to 28, 1925.

This race of lizards exhibits, in Lower California, much the same choice of surroundings as in localities farther north, in California. Out of a total of twenty-seven specimens, twenty-two were shot as they clung to rocks or boulders which were sometimes on dry, sandy sidehills. Some of the lizards were among pine trees in a forest. The remaining five individuals were obtained from slightly varying situations as follows: in mouse trap set among manzanita bushes, under rocks near a creek, on a burned log, on sandy ground, under willows.

Sceloporus occidentalis bi-seriatus Hallowell

Laguna Hanson: 10484–86; October 8, 9 and 12, 1926.
Concepción: 9893; November 15, 1925.
San José, latitude 31°: 9642–51; September 28, October 17, 19 and 24, 1925.
La Grulla: 9745–47; May 5, 7 and 22, 1925.
Aguaje del Sauce: 9742–44; April 29 and 30, 1925.
Valladares: 9731–32, 9736; April 14, 18 and 19, 1925.
San Ramón: 9739–40; April 25 and 27, 1925.

Places of capture of this kind of lizard varied as follows: At Laguna Hanson two were caught in mouse traps—one of them among rocks, and one was shot as it clung to a log. The specimen from Concepción was found under a small bush on a hillside. At San José one individual was caught in a ranch house and seven were found beneath boards and stones around the ranch. All the lizards in the latter lot were numb from cold and so were easily picked up. One specimen from La Grulla was shot as it clung in a willow tree, one was found beneath willows, and another was snared on top of a bag of stuffing cotton. Three individuals were obtained at Aguaje del Sauce—two from a willow tree and one from beneath a scrub black oak. Valladares specimens were taken in brush in a cañon, in a mouse trap set among willows, and on a willow near a creek. Both specimens from San Ramón were obtained near a creek, one of them on a willow tree and the other from a rock beneath willows.

Sceloporus magister magister Hallowell

El Major: 9544; April 25, 1926.
Las Palmas Cañón: 10724; November 5, 1927.
Seven miles east of Cerro Prieto: 10755–56; May 23 and 27, 1928.

The specimen from El Major was shot among leaves in a willow thicket near a well. The one at La Palmas Cañon was found "asleep" in early morning on the main part of a small limb in a mesquite tree. Two individuals were taken near Cerro Prieto, one of them resting, head down, on the trunk of a small willow tree, the other under some loose boards.

The close structural similarity of this form to the two following races, as pointed out by Van Denburgh (1922), suggests that they are too closely related to be considered as distinct species. Study of the specimens available shows that the three forms differ as subspecies both in coloration and in their respective geographic ranges.

The ascription of this form to "northwestern Lower California" by Schmidt (1922, p. 661) is obviously a misprint for northeastern Lower California.

Sceloporus magister rufidorsum Yarrow

San Telmo: 9728–30; March 28 and April 5, 1925.

Valladares: 9734; April 16, 1925.

San Ramón: 9727, 9885–86; March 18 and 22, 1925.

Socorro: 13576; February 25, 1931.

El Rosario: 13559–75; December 21, 1930.

Cedros Island: 9691–94; July 23 and 26, 1925.

San Ignacio: 10650–52, 10655, 10657–58, 13593–96, 13598–606; April 11 to 26, 1927, and July 25 to August 1, 1931.

Comondú: 13589–90; April 6 and 7, 1931.

San Jorge: 13607–08; April 28 and 29, 1931.

El Medano: 13609–10; May 17 and 18, 1931.

Magdalena, Santa Magdalena Island: 13611–17; May 28, 30 and 31, and June 1 and 4, 1931.

Almejas Bay, Santa Margarita Island: 13618–22; June 6, 11, 12 and 13, 1931.

Southwest end San José Island: 11726–27; February 26 and March 1, 1929.

A large number of specimens of this lizard was caught in traps set on the ground for small mammals. This indicates that this species compared with some other kinds of lizards spends a relatively large proportion of its time foraging on the surface of the ground. Situations that appear to be especially favored by this species were dry arroyos and sandy or gravelly plains or mesas. A good many individuals were obtained beneath or beside bushes on brushy ground. Additional individuals were taken in places as follows: Under rocks near rocky ledge; from top of rocks; on some old boards just above beach; under a rotten log; in a house. On December 21, 1930, at El Rosario six lizards of this kind were dug out of the ground by a Mexican boy. These animals evidently were in hibernation places.

The range here considered as occupied by this race embraces the area of northwestern Lower California and southward, including the central portion of the peninsula to the Cape region. Specimens from the more southern of the localities listed above show intergradation toward the race *S. m. zosteromus,* especially in lateral markings.

Sceloporus magister zosteromus Cope

Triunfo: 13623–24; June 22 and 24, 1931.

Eureka: 11733; August 31, 1929.

Todos Santos: 11712–25; October 14, 15, 18 and 26, 1928.

Agua Caliente: 11729–32; June 1, 21, 24 and 26, 1929.

Santa Anita: 11728; April 26, 1929.

The single specimen from Eureka was shot in a sandy road. At Agua Caliente individuals were taken in some fallen brush, beside an old dry cowhide, and among leaves under a tree. At Santa Anita one was obtained in a brush pile on bottomland.

My conclusion regarding the range of this form, as indicated in the above list of localities, leaves it with a more restricted range than has been ascribed to it previously (see Van Denburgh, 1922, p. 351). The specimens now available indicate that *S. m. zosteromus* is a race strictly limited to the Cape district of Lower California.

Sceloporus orcutti Stejneger

Laguna Hanson: 10482–83; October 11 and 20, 1926.
San José, latitude 31°: 9600; May 10, 1926.
El Cajón Cañon: 9601–08; May 10 to June 2, 1926.
La Grulla: 9748; May 25, 1925.
Valladares: 9733; April 27, 1925.
San Antonio Ranch: 9741; April 15, 1925.
Cataviña: 13577–86; March 18 to 23, 1931.
San Ignacio: 13597; July 29, 1931.
Comondú: 13587–88, 13591–92; April 1, 7 and 10, 1931.

Twenty-two of the thirty specimens of this species were obtained from rocks. They were either perched on the tops or clinging to the sides of the boulders. Most of the places were at the margins of meadows, close to streams, or on cañon walls. Other places of capture were as follows: on willow limb at edge of swampy ground; in mouse trap under a "tuna cactus"; on rocky ledge under a shrub; on the ground in old corral; picked up by hand in early morning in a trail.

This form, although it superficially resembles *S. magister* in many ways, appears not to intergrade with that species in characters of structure or coloration. As further indication of the specific distinctness of these two forms it may be pointed out that the same general area is occupied by both; at several collecting stations specimens of this species and *S. m. rufidorsum* were obtained. The records listed above indicate a considerable extension of range to the southward for this species.

Sceloporus licki Van Denburgh

Todos Santos: 11701; October 12, 1928.
Agua Caliente: 11709–11; June 7 and 25, 1929.
El Sauz: 11702–08; November 21 and 25 and December 10, 1928.

About half the specimens obtained were shot as they clung to the surfaces of rocks on sidehills and at the edges of cañons. The others were shot from rails of an old fence in a corral.

Phrynosoma coronatum coronatum (Blainville)

Cornicabra: 13628; May 3, 1931.
Santo Domingo, latitude 25° 31′: 13629; May 6, 1931.
Five miles south of Refugio: 13630; May 12, 1931.
Medano Amarillo, Magdalena Bay: 13631; June 15, 1931.
Triunfo: 13632; June 24, 1931.
Eureka: 11741–67; August 21 to 31, 1929.
Todos Santos: 11734–39; October 20 to November 3, 1928.
Agua Caliente: 11740; June 20, 1929.
Miraflores: 13633–36; July 1, 2, 4 and 5, 1931.

All the forms here considered as belonging to the species *Phrynosoma coronatum* agree in having several (three or more) longitudinal series of enlarged, pointed gular scales on each side; a series

of very large spinose plates below the lower labials; and large head spines. The race *coronatum* has no spine behind the broad subrictal and the head plates of adults are chiefly black or dark brown with yellow edges.

The systematic treatment of the species of *P. coronatum* and related forms has always been unsatisfactory, mainly because the known specimens were so few and from such scattered localities that the continuity of the population could not be demonstrated, nor could intergradation in structural characters adequately be shown. The specimens available in the present collection, while insufficient for a final treatment of this group, are adequate to show that a new arrangement of these forms is desirable and to indicate what the new arrangement should be. This necessitates considering all horned toads of the coastal region from San Francisco Bay to the Cape region of Lower California as one species, *Phrynosoma coronatum* (the first named in the group). This species, as I see the material, is made up of four mainland races and one insular form as follows:

Phrynosoma coronatum coronatum (Blainville).
Phrynosoma coronatum jamesi Schmidt.
Phrynosoma cornatum blainvillii Gray
Phrynosoma coronatum frontale Van Denburgh.
Phrynosoma coronatum cerroense Stejneger.

Phrynosoma coronatum blainvillii Gray

Three miles west of San Vicente: 9586; May 7, 1926.
San José: 9587, 9779; May 5, 1925, May 9, 1926.
San Telmo: 9778; May 4, 1925.
Valladares: 9777; April 15, 1925.
San Ramón, Santo Domingo River: 9776; March 21, 1925.

Most of the specimens listed here were picked up in roads or on sandy plains. The one individual from Valladares was under a greasewood bush on top of a hill where the soil was red clay.

Examples of the race *P. c. blainvillii* possess a long spine just behind the broad subrictal spine. The head plates of adults are mostly yellow, sparsely dotted with brown. They are larger centrally, convex, and almost smooth.

After examining the six specimens listed above and comparing them with specimens of *P. c. blainvillii* from southern California and a topotype of *P. nelsoni* Schmidt (1922, p. 666), it seems best to consider the last mentioned form as not deserving recognition by name. Specimens from San Quintín it seems best to consider as intergrades between *P. c. blainvillii* and *P. c. jamesi*, but more nearly like *P. c. blainvillii*. Geographically there appears to be no room for this proposed form on the peninsula.

Phrynosoma coronatum jamesi Schmidt

Three miles west of Calmallí, 1400 feet altitude: 13625; March 26, 1931.
Thirty and twenty miles north of San Ignacio: 13626–27; March 27, 1931.
San Ignacio: 10659–60, 13637–40; April 18 and 27, 1927, July 27 to 30, 1931.

In the race *P. c. jamesi* there is a slender elongate postrictal spine about as long as the subrictal. The subrictal does not overlap the last of the sublabials and is nearly in line with them. The lower of the two lateral fringes is weak and the occipital spines are slender.

The nine individuals listed above agree essentially with the description of the form *jamesi,* named by Schmidt (1922, p. 668). They suggest that this race occupies the whole central portion of the peninsula and that in range and structural characters it forms a connecting race between *P. c. blainvillii* and *P. c. coronatum.*

Phrynosoma platyrhinos Girard

Twenty miles north of San Felipe: 9545; March 22, 1926.

The single specimen was taken as it ran along a road in front of an automobile.

Gerrhonotus multi-carinatus (Blainville)

El Sauz: 11769–71; November 19 and 25, 1928.
Todos Santos: 11768; October 29, 1928.

The three individuals taken in November were about an old hut; one under a log, one under rubbish, and one was running over the wall.

Gerrhonotus scincicauda webbii Baird

South Island, Los Coronados Islands: 5402–03; July 1, 1913.
San José, latitude 31°: 9655, 9784, 9790–91, 9892; May 2 and 7, October 19, and November 24, 1925.
La Grulla: 9785–88; May 12, 17 and 22, 1925.
El Cajón Cañon: 9588; May 28, 1926.
Valladares: 9781–83, 9789; April 15, 16 and 20, 1925.
San Martín Island: 9699–702; July 8, 13, 15 and 16, 1925.
San Ramón: 9780; March 21, 1925.
Socorro: 9891; November 23, 1925.

The habitat of this lizard in Lower California is indicated by the following descriptive phrases which characterize the places of capture of many of the individuals obtained. At San José one lizard was caught in a tangle of dead brush under willows in a creek bottom, one was in a ditch among some dead limbs, another was under willows near a creek, and two were caught with a noose on the trunks of willows. At La Grulla specimens were taken under willows near a creek, in a tent which was on dry sand among pines, and one was caught in a mouse trap under willows. The single specimen from El Cajón Cañon was killed while clinging to a large willow limb near a stream. Four

specimens were taken at Valladares, all among willows. One of these was caught in a mouse trap and another was shot beneath some driftwood. On San Martín Island two individuals were taken among lava blocks, one was found crawling around a refuse pile, and a fourth was taken among boards near a permanent camp on the island.

That red-tailed hawks may sometimes capture and eat this kind of lizard is shown by the experience of a collector at La Grulla on May 22, 1925. A *Gerrhonotus* was dropped from the talons of one of these hawks when it was shot.

Anniella pulchra Gray

North end of Nachogüero Valley: 10725; November 23, 1927.
South Island, Los Coronados Islands: 5401; July 1, 1913.
Todos Santos Island: 10490–91; January 11 and 17, 1927.

The specimen from Nachogüero Valley was brought in by a Mexican who caught it while digging an irrigation ditch. Both the individuals from Todos Santos Island were found beneath stones.

Cnemidophorus maximus Cope

Triunfo: 13757; June 19, 1931.
Todos Santos: 11811–16; October 12 to 16, 1928.
Agua Caliente: 11817–20; May 31, and June 2 and 22, 1929.
Miraflores: 13758; July 1, 1931.

Situations where individuals of this lizard were found are as follows: among cactus on sand, at base of a brush fence, in a clear space among trees, and in a sandy trail.

Cnemidophorus tesselatus tesselatus (Say)

Colorado River, twenty miles south of Pilot Knob: 10726–27; October 17, 1927.
Seven miles east of Cerro Prieto: 10757–60; May 25 and 26, June 1 and 4, 1928.
South Island, Los Coronados Islands: 5399; June 24, 1913.
El Major: 9556, 9558; April 24 and 27, 1926.
San José, latitude 31°: 9652–3, 9797–99, 9802; May 5, June 14, October 17 and 22, 1925.
San Felipe: 9548–55, 9557; March 23 to April 24, 1926.
Valladares: 9792–95, 9800–01; April 14 to 25, 1925.
El Cajón Cañon: 9593–99; May 15, 19, 24, 25 and 27, and June 2, 1926.
San Antonio Ranch, 2100 feet altitude, San Antonio River: 9796; April 25, 1925.
Cataviña: 13729–44; March 19 to 27, 1931.
Cedros Island: 9695–98, July 22 to 26, 1925.
Calmallí: 13745–48; March 27, 1931.
San Ignacio: 13759; July 18, 1931.

Habitat preferences of this lizard are indicated by the following notes on the surroundings where specimens were captured. At the

Colorado River specimens were taken on a dead stump and on sandy ground. Near Cerro Prieto: on old railroad ties; under quail brush; feeding, on bare earth. El Major: among sticks under willow thicket; in mouse trap under mesquite. San José: under board in yard; dug out, while making barbeque pit; on sandy flat among sagebrush; in a garden among pea vines. San Felipe: on sand between bushes; on open desert; on gravel fan near base of mountains; at edge of frutia bush. Valladares: among rocks on dry hillsides; in mouse trap at base of large cottonwood tree; among bushes in dry wash; in mouse trap under greasewood in rocky, sandy draw; under brush on sandy hill; under bush on red clay hillside. El Cajón Cañon: in mouse traps; among willows; among rocks in bed of stream; among rocks and brush near stream; among rocks at base of hill; among rocks on flat; on sandy, gravelly soil; among willow brush at river bottom. San Antonio Ranch: under brush on sandy flat. Cataviña: among rocks at cañon side; on a rock at base of cliff; on a palm trunk. Calmallí: four on outer edge of cactus clumps.

Although specimens from all the localities listed above are here placed under one subspecies, following Burt (1931*a*), this treatment of the species is considered to be not entirely satisfactory. The material available, although limited in amount, seems to show too marked a geographical variability to be placed in one race. Of course the individual and age variability in this species show so great a range as to make it difficult to place a proper valuation on the characters that are shown by populations. The actual specimens, as shown in the above list, are, however, insufficient to permit more than an opinion that a reconsideration of the whole species, with more attention given to the mean characters of populations and less to overlap shown by individual specimens, would result in more races being recognized than Burt's conclusions show. This does not necessarily mean that all the races previously named should be considered valid. For example, I agree, on the basis of specimens in this collection, that it is not practicable to recognize the form *multiscutatus*.

The single specimen from San Ignacio appears to be an intergrade toward the race *rubidus*.

Cnemidophorus tesselatus rubidus Cope

Comondú: 13749–52; April 1, 9, 15 and 16, 1931.

El Medano: 13753; May 17, 1931.

Magdalena, Santa Magdalena Island: 13754; May 30, 1931.

Almejas Bay, Santa Margarita Island: 13755–56; June 6 and 8, 1931.

Situations of capture for this subspecies varied as follows: Comondú, among rocks at cañon side; El Medano, in trail through brush in sandy arroyo; Magdalena, about pile of rubbish; Almejas Bay, on gravelly soil on a mesa and on ground among weeds.

Cnemidophorus hyperythrus hyperythrus (Cope)

Magdalena, Santa Magdalena Island: 13644–49; May 28, 30 and 31, 1931.
Yrais: 13642; May 15, 1931.
El Medano: 13643; May 26, 1931.
Almejas Bay, Santa Margarita Island: 13650–55; June 6 to 12, 1931.
Triunfo: 13656–73; June 19, 20, 22 and 23, 1931.
Todos Santos: 11772–84; October 12 to 19, 1928.
Eureka: 11786–810; August 16, 17, 22 and 23, 1929.
San José del Cabo: 11785; April 10, 1929.

The population of *C. hyperythrus* in southern Lower California, which is here considered as belonging to the race *hyperythrus* shows characteristics which distinguish it from the races to the north as follows: The main portion of the specimens exhibit a dorsal pattern of three distinct longitudinal lines. Fifteen individuals, or fewer than one-fourth of the total, have two distinct dorsal lines, while only three (from Eureka) have a single dorsal line with a Y-shaped fork anteriorly, which is less than one-third the whole length of the line.

TABLE 2

Variation in *Cnemidophorus hyperythrus* from Lower California

	Cataviña	San Ignacio	Magdalena	Yrais	El Medano	Almejas Bay	Triunfo	Todos Santos	Eureka	San José del Cabo
Number of dorsal lines:										
3			5		1	5	18	10	13	1
2		2	1	1		1		3	9	
1 with anterior Y more than ⅓ length		22								
1 with anterior Y less than ⅓ length	1	37							3	
Number of supraoculars:										
3	1	2				2	5	5	11	
3 and 4		1				1	1			1
4		58	6	1		3	12	8	14	
Anteriormost supraoculars bordered by granules:										
Part of third		10					5	4	9	1
Third		48	3			4	12	8	15	
Part of second	1*	3	3	1		2	1	1	1	

* Complete

In the number of supraocular scales and of extent of the line of granules separating the frontal from the supraocular this race is separated from *C. h. schmidti* less distinctly than by color characters,

but in these structural characters there appear to be good racial distinctions. For details of these characters see table 2. Specimens from Santa Margarita and Santa Magdalena islands appear to belong to this race. These localities were considered by Schmidt (1922, p. 679) and Van Denburgh (1922, p. 562) to belong in the range of *C. h. beldingi*.

Cnemidophorus hyperythrus schmidti (Van Denburgh and Slevin)

Cataviña: 13641; March 21, 1931.

San Ignacio: 10661–66, 13674–728; April 11, 16 and 18, 1927, March 29 and July 23 to August 2, 1931.

On the basis of the distribution of color markings and structure as shown in table 2 it appears necessary to consider the series of sixty-one specimens from San Ignacio as representing a race distinct from the race in the southern portion of the peninsula and distinct from *C. h. beldingi* in northern Lower California and California. This latter race is not represented in the present collection from Lower California, but there are specimens from California which bear out this conclusion.

The chief character of this race is the possession of a single mid-dorsal line, forked anteriorly. In more than half the specimens in the present series the Y-shaped portion is less than one-third the whole length of the line.

The treatment here given this species is not in agreement with the conclusions reached by Burt (1931*a*). The difference seems to be more a matter of interpretation of materials than of a difference in the characters in the actual specimens studied. For one thing the geographic groups compared by Burt (p. 235) seem too extensive to show the true nature of the geographic variation.

Eumeces skiltonianus skiltonianus (Baird and Girard)

South Island, Los Coronados Islands: 5400; July 1, 1913.

Todos Santos Island: 10487–89; January 14 and 17, 1927.

La Grulla: 9803; May 17, 1925.

San José, latitude 31°: 9654; October 17, 1925.

One of the specimens listed above was found beneath a board, two under rocks, and one was caught in driftwood near a creek.

Three of the specimens, numbers 5400, 9803, and 10488, have the parietals completely separated by the interparietal. The other three show contact, but for only a slight distance, posteriorly between the parietals. None of the six shows a salmon-colored tail. Evidently the population from the northern portion of the peninsula shows intergradation with the more southern form, *E. s. lagunensis*.

Eumeces skiltonianus lagunensis Van Denburgh

Comondú: 13760; April 9, 1931.

The description of the species *Eumeces lagunensis* was based upon two specimens from San Francisquito, Sierra Laguna, Lower California. They differed from *E. skiltonianus* in having the tail salmon-colored instead of blue and in having the interparietal smaller than either frontoparietal instead of larger and not separating the parietals.

The individual listed above from Comondú not only agrees with the description as given originally by Van Denburgh (1895, p. 134) but it provides an additional locality of occurrence for the species. It therefore helps to confirm the opinion expressed by the describer of the species (1922, p. 589) that it should be recognized as distinct. However, considering the facts that the gap in structural characters is small and that specimens from the northern part of the peninsula appear to be somewhat intermediate between the two forms (see Loveridge, 1930, p. 111), it seems best to consider *lagunensis* as of subspecific rank. Apparently the salmon-colored tail is a character of geographic significance. Even though it does appear in southern California-taken specimens, it is by no means typical of individuals from the northern part of the range of *E. skiltonianus*.

The two specimens upon which the diagnosis of *E. lagunensis* was based are no longer in the collection of the California Academy of Sciences. They were destroyed in the San Francisco fire of 1906.

Bipes biporus (Cope)

Santo Domingo, latitude 25° 30′: 13761; May 5, 1931.
Todos Santos: 11821; October 20, 1928.

The specimen listed from Santo Domingo was brought to Mr. Lamb by a boy who found it in the ground at the edge of a sandy arroyo. The two records presented here provide two additional locality records for the species as well as extend the known range to a point more than one-fourth the length of the peninsula north from the southern tip. The two localities of previously known occurrence are La Paz and Cape San Lucas.

Leptotyphlops humilis humilis (Baird and Girard)

San Ignacio: 10667; April 11, 1927.
San José, latitude 31°: 9637; May 10, 1926.

The specimen from San José was found by a man while digging in an irrigation ditch.

Leptotyphlops humilis slevini Klauber

Eureka: 11851–52; August 26, 1929.

Lichanura roseofusca roseofusca Cope

Five miles west of San José, Sierra San Pedro Mártir: 9890; November 25, 1925.

The snake listed above was found on open ground of a "dry bog." This specimen was loaned to L. M. Klauber who made use of it in his recent publication (1931*a*) dealing with this genus.

Lichanura trivirgata Cope

Todos Santos: 11822; October 24, 1928.
Eureka: 11823–24; August 24 and 27, 1929.

These three snakes were loaned to Klauber who has recently (1931*a*) published the results of his study of them.

Masticophis piceus (Cope)

Agua Chiquita: 9808; June 17, 1925.
Santo Domingo River: 9810; March 24, 1925.

The snake from Agua Chiquita was found under a large board which was flat on the ground among brush clumps. It was before daylight and the snake was too cold to move; therefore it was caught easily. The other snake was shot while lying in the sun at the edge of brush on a sandy bank near a marsh. Total length relaxed was five feet, one inch (1550 mm.).

Recognition here of this form as a distinct species is based upon the discussion given it by Ortenburger (1928, pp. 125–134) and by Klauber (1931*c*, pp. 37–38).

Masticophis flagellum frenatus (Stejneger)

San Ignacio: 10668–69; April 9 and 25, 1927.
Comondú: 13762–63, 13854–55; April 9, 10 and 16, 1931.
Magdalena, Santa Magdalena Island: 13764; June 1, 1931.

One of the racers from Comondú was found among rocks by a Mexican boy. The one obtained on Santa Magdalena Island was found under a low bush on the desert.

Masticophis lateralis (Hallowell)

El Cajón Cañon: 9632, 9640; May 29 and June 3, 1926.

One individual was taken in dry foxtail grass near a creek. The other one was caught in a rat trap set under a mesquite bush on a rocky flat.

Salvadora grahamiae hexalepsis (Cope)

San Ignacio: 10670–71, 13765; April 11 and 18, 1927 and July 30, 1931.
Eureka: 11838; August 22, 1929.

Number 10671 has three preoculars, the upper one on each side being split into two. Both the others have two preoculars. Number 10670 has ten supralabials and eleven infralabials. Otherwise these specimens agree closely with the average for the species as defined by Van Denburgh (1922, p. 690).

Phyllorhynchus decurtatus (Cope)

San Ignacio: 13766; July 29, 1931.

The specimen listed above shows characters as follows: Scale rows, 19; gastrosteges, 156; urosteges, 34; anal plate, undivided; supralabials, 6; infralabials, 8; preoculars, 2; postoculars, 2; 32 dorsal spots on body; lateral spots present; 7 spots on tail; length of body, 285 mm.; length of tail 45 mm.; ratio of tail length to total length, .13. Here then is a specimen additional to the ones mentioned by Schmidt (1922, p. 685) which combines the scale characters of *P. browni* with the color characters of *P. decurtatus.* It agrees with *decurtatus* in having the posterior dorsal scales smooth.

Elaphe rosaliae (Mocquard)

San Ignacio: 10672; April 11, 1927.
Comondú: 13767; April 11, 1931.

The specimens listed here are the third and fourth known to be collected of this species. The type specimen was from Santa Rosalia, on the gulf side of the peninsula at about the latitude of San Ignacio. The second specimen was found by Mr. Slevin at San Bartolo, in the Cape region. The individual from Comondú helps to fill in the gap between the other localities.

Coloration of these two specimens agrees with the description given by Van Denburgh (1922, p. 699). This was confirmed by my examination on January 19, 1932, of the specimen described by him. They agree also in scalation with the two individuals described by Van Denburgh, as is shown by the following tabulation:

TABLE 3

Number	Scale rows	Gastrosteges	Urosteges	Anal	Supralabials	Infralabials
10672	35	288	88	+	11	14
10767	32	277	85	+	11	13

Arizona elegans occidentalis Blanchard

Santo Tomás: 9809; June 19, 1925.

The only specimen obtained was picked up at 6 o'clock in the morning, just as the sun was coming up. The snake had just captured a lizard (*Sceloporus*) which it swallowed alive.

Dorsal spots on this individual tend to break in the mid-line and the two halves to alternate rather than to meet and form a narrow bar across the back. In other characters it agrees with the race *A. e. occidentalis* recently described by Blanchard (1924, p. 1).

Pituophis catenifer annectens Baird and Girard

Laguna Hanson, Sierra Juárez: 10492; October 21, 1926.
San José, latitude 31°: 9662, 9813, 9889; May 4, and October 17 and 25, 1925.
San Martín Island: 9703–06; July 8 and 16, 1925.
Mouth of Rosario River: 13768; December 22, 1930.

The gopher snake from Laguna Hanson was found at 5200 feet altitude. It was crawling among the pine needles. At San José three specimens were taken in situations as follows: under willows near a camp; crawling through the grass in a creek bottom; in an orchard among weeds and grass. On San Martín Island two individuals were caught among some boards in a camp, one was shot in a bare space among lava, and a fourth was caught in a rat trap among some thorny brush in the lava. This one, before it was caught, tried to swallow a mouse that had been caught by the tail.

Pituophis catenifer deserticola Stejneger

Twenty-three miles north of El Major: 9562; April 30, 1926.

The snake listed above was found coiled in a sandy road. Its scales are in 35 rows, gastrosteges 244, urosteges 50, anal 1, supralabials 8, infralabials 13. There are 46 blotches on the body and 11 on the tail.

Pituophis vertebralis (Blainville)

San Ignacio: 10673–74; April 15 and 24, 1927.
Todos Santos: 11839–42; October 20, 22 and 25, 1928.
Eureka: 11844; August 22, 1929.
Santa Anita: 11843; April 26, 1929.

Lampropeltis getulus conjuncta Cope

Comondú: 13769; April 15, 1931.
Todos Santos: 11847; October 31, 1928.
Eureka: 11849; August 25, 1929.
Agua Caliente: 11848; June 6, 1929.

The specimen from Comondú is of special interest because it extends the known range of this form for a considerable distance northward. It has scales in 23 rows, gastrosteges 242, urosteges 21, anal 1, supralabials 7, infralabials 9, preocular 1, postoculars 2, and 40 white rings on the body. Distribution of white markings on the scales of the head is characteristic of *conjuncta* from the Cape district.

Lampropeltis getulus yumensis Blanchard

Seven miles east of Cerro Prieto: 10761–62; May 25 and 30, 1928.
El Cajón Cañon: 9630–31; May 14 and 24, 1926.

One of the specimens from near Cerro Prieto was found crawling at the margin of tules; the other one was caught inside an old house. Both the individuals from El Cajón Cañon were caught near a creek, one of them on sandy ground.

Lampropeltis californiae nitida Van Denburgh

Agua Caliente: 11845–46; June 3, 1929.

One of the snakes listed above was shot as it crawled on the ground at the base of a brush fence. The other one was found at night while the collector was hunting owls. A toad (*Bufo punctatus*) was heard making an unusual croaking sound. When a light was flashed in the direction of the sound this king snake was discovered about to eat the toad.

This form previously has been known from four specimens only; three from San José del Cabo (Van Denburgh, 1922, p. 768) and one from Miraflores (Schmidt, 1922, p. 690).

Lampropeltis zonata (Lockington)

Laguna Hanson: 10493; October 9, 1926.

The single individual captured was found crawling over the pine needles under a pine tree at the edge of a meadow at 6400 feet altitude in the Sierra Juárez Mountains at about 32° latitude.

The present individual, a small one, measures 285 mm. in length of body to anus, and 50 mm. in length of tail. Supralabials, 7; infralabials, 9; postoculars, 3; preocular, 1; scale rows, 21; gastrosteges, 209.

Coloration: Snout mainly black but with spots of light color, probably red in live animal but now faded to brownish white, on rostral,

internasals, supraoculars, several of the supralabials, on nasals preoculars, loreals, and a large area on posterior halves of prefrontals and anterior tip of frontal. White band crosses back of head on posterior halves, but not to tips of parietal plates. Back of this is a black ring which joins the second black ring on lower side of body. First ring of red, on upper surface, reaches down sides but is not connected on lower side of body. Width of red rings on body about equal to or narrower than combined black and white rings. White rings on body 46, on tail 8.

Van Denburgh and Slevin (1923, p. 2) have described a king snake from the San Pedro Mártir Mountains, proposing for it the name *Lampropeltis agalma*. The chief diagnostic character attributed to this proposed new species to distinguish it from *L. zonata* is "upper surface of snout largely red instead of black."

An examination of the sixteen specimens of *L. zonata* in the Museum of Vertebrate Zoology shows that three have light color on the snout. Although this color has now faded to pale brown it was probably red or pink in the living animals. Number 4303 has the light color limited to the margins of the supraoculars. In number 8175 the light area is more broken but is slightly larger than in the individual from Laguna Hanson. Number 1224 has almost exactly the same area light colored as the Lower California specimen. In the former the color is slightly darker. The Lower California specimen is much the smaller of the two but the color on the body is much brighter at present. In other characters the snake from Laguna Hanson is within the range of variation for the species *L. zonata* in California.

The facts cited above lead to the conclusion that the characters ascribed to *L. agalma* are not sufficiently distinctive to allow the recognition of it as a species distinctly separable from *L. zonata*. The study of more material might indicate a desirability of recognizing a race of *L. zonata* on the mountains of northern Lower California. However, for the present it seems best to consider all the specimens from California and Lower California as of the species *L. zonata*, without subspecies.

Reasons for the use of the name *zonata* rather than *multicincta*, the name adopted by Blanchard (1921, p. 222) and Stejneger and Barbour (1923, p. 100), are as follows: Blainville (1835, p. 293) gave the name *Coluber zonatus* to a snake which he described so incompletely that, after the type had been lost, Stejneger (1902, p. 153) considered the case and recommended that the name be dropped "altogether as unidentifiable with any known snake." Lockington (1876, p. 52) described the present species, giving it the name *Bellophis zonatus*. Van Denburgh is authority for the statement that the types for this species "were two in number and were labeled Santa Barbara, but probably were collected in the mountains near there, and that they were in the Academy's collection until destroyed by the great fire in April, 1906" (Blanchard, *loc. cit.*).

Since Blainville's name cannot be assigned to any known species it need not be considered in this case, for Lockington assigned the species he described to a separate genus. Thus he, probably unin-

tentionally, insured his species against being considered a synonym of *Coluber zonatus.* It seems plain that *Bellophis zonatus* Lockington (1876) is the earliest name to be applied correctly to this species. The name given to it by Yarrow (*Ophibolus getulus multicinctus*) was not applied until 1882.

Sonora episcopa (Kennicott)

Comondú: 13770–73; April 2, 9 and 14, 1931.

The four specimens listed above were brought in by boys who said that they obtained them from among lava rocks. These individuals are all unicolor, none showing any trace of longitudinal stripes or cross bands. Scalation and measurements are shown in table 4.

TABLE 4

Number	Scale rows	Gastrosteges	Urosteges	Anal	Supralabials	Infralabials	Length of body in mm.	Length of tail in mm.
13770	15	151	48	÷	6	7	285	65
13771	15	155	48	÷	7	7	292	72
13772	15	154	42	÷	7	7	260	57
13773	14	152	45	÷	6	7	290	70

In using the name *Sonora episcopa* for the unicolor lot of specimens from Lower California, I follow Klauber (1931*c*, p. 38). The four specimens considered above conform to the conclusions reached by him.

Hypsiglena ochrorhynchus Cope

San Ignacio: 13775; July 27, 1931.
Comondú: 13774; April 13, 1931.
Eureka: 11905–06; August 23 and 28, 1929.

Natrix valida (Kennicott)

Agua Caliente: 11909–11; June 3, 6 and 9, 1929.
San José del Cabo: 11907–08; April 6, 1929.

At Agua Caliente a water snake was caught among rocks in an arroyo. Both specimens from San José del Cabo were caught in rat traps, one of which was set among tules.

Both types of coloration described by Van Denburgh (1922, p. 786) are exhibited in the present series. The three snakes from Agua Caliente show the melanistic type of coloration as described by Van Denburgh. The two individuals from San José del Cabo exhibit the normal pale type of coloration. In this case, with so few specimens, there is an apparent segregation geographically of these two distinctive color phases. Van Denburgh, however, with a much larger series available, concluded that the melanistic type "doubtless is only an individual variation."

Thamnophis ordinoides hueyi Van Denburgh and Slevin

La Grulla: 9807; May 10, 1925.

The specimen here listed was caught among rocks on sidehill near a meadow at 7200 feet altitude. Gastrosteges number 151 in this individual. It thus possesses the chief distinguishing feature characteristic of this recently described race (1923).

Thamnophis ordinoides hammondii (Kennicott)

San José, latitude 31°: 9636, 9641, 9805–06; May 4 and 6, 1925 and May 9 and 10, 1926.

San Telmo: 9812; March 28, 1925.

El Cajón Cañon: 9633–35; May 15 and June 2 and 3, 1926.

San Ramón: 9811, 9887; March 16 and 22, 1925.

San Antonio Ranch, 2100 feet altitude, San Antonio River: 9804; April 27, 1925.

San Ignacio: 10676–80, 13783–92, 13856; April 9 to 17, 1927, March 29 and July 25, 1931.

Comondú: 13782; April 2, 1931.

The following places of capture of this garter snake indicate its choice of habitat in Lower California: among damp grass in marshy ground; curled in a bare spot near creek; under willows near creek; at edge of creek under willow brush; among damp grass and rocks at edge of stream; at water's edge among loose rocks and sand; in "spear grass" near marsh; at edge of marsh; on the ground under a mesquite tree.

Chilomeniscus stramineus Cope

Eureka: 11852–902; August 22 to 29, 1929.

Chilomeniscus cinctus Cope

San Ignacio: 10675, 13781; April 9, 1927 and July 27, 1931.

Comondú: 13776–80; April 6 and 8, 1931.

Systematic treatment of the genus *Chilomeniscus* has always been rather uncertain because the known specimens were few and from scattered localities. Also the wide range of variation in color pattern has added to the confusion in attempts to identify individuals. The present lot of seven specimens is especially valuable because only two localities are represented and because a great range of variation in color is exhibited.

In general, color in the whole series is reddish orange above but showing various degrees of evident fading. The body is crossed by dark brown bars, bands, or rings. It is in the number and extent of these markings that most of the individual variation occurs.

Number 10675 has twenty-three dorsal bars on the body and five on the tail. The tips of the dark markings extend down to the first

row of scales. The undersurface and the spaces between the bars are unmarked.

Number 13781 has twenty-four dorsal bars on the body and five on the tail. The tips of the dark markings extend only to the ends of the gastrosteges in the anterior portion of the body, but farther back they extend, though brokenly, entirely across the ventral surface. Scattered irregularly on the gastrosteges, not always in line with the crossbands, are spots of the same color as the crossbands. A few of the scales on the dorsolateral surfaces, and between the crossbands, have dark brown dots in their centers.

Number 13776 has twenty-two bands on the body and three on the tail. At the anterior end of the body the dark bands barely extend onto the gastrosteges. Progressively backward the tips of the bands are closer and closer together until the posterior ones are separated by a distance smaller than the width of a scale. The coloration on this specimen is somewhat clouded in appearance owing to the loosened skin which apparently is nearly ready to be shed.

Number 13777 has forty dorsal bands on the body and eight on the tail. This individual has almost twice as many crossbands as number 13781 even though that specimen is actually longer. The bands extend down to the first row of scales and, in some cases, partly through it. The lower surface is whitish and unspotted. Coloration of the areas between the bands shows a slightly faded, pinkish cast. About four rows of the scales down the middle of the back are unmarked in these spaces. On the sides, however, except for the lowest row or two, each scale in an interspace has a brown spot in its center. This arrangement extends the full length of the body and tail.

Number 13778 has twenty-three dorsal bands on the body and four on the tail. Except for the anteriormost three and one or two others which do not quite meet, these bands form complete rings around the body. Several of the rings are slightly broken where they cross the gastrosteges. There are no spots on the interspaces. This specimen has the coloration slightly obscured by the loosened outer layer of skin.

Number 13779 has thirty-five dorsal bands on the body and six on the tail. The bands extend down into the first row of scales. In the interspaces the reddish orange shows about as conspicuously as in number 13778. A few scales on the sides of the body, two or three in each interspace, have brown spots in the center.

Number 13780 has thirty-four dorsal bands on the body and eight on the tail. These bands extend, on the average, to the tips of the gastrosteges. All the scales of the interspaces, except a few scattered ones in the middle of the back and on the first row of scales on the sides, have brown spots in the center. This specimen, then, exhibits the coloration that formerly has been considered as distinguishing an insular species (*C. punctatissimus*).

Study of the coloration in this series of seven specimens, five of them from one locality, points rather definitely to the conclusion that the patterns previously considered as typical of distinct species are really only examples of an exceptionally variable species.

Trimorphodon lyrophanes (Cope)

Todos Santos: 11903–04; October 15 and 17, 1928.

Both these snakes were brought into camp by a small boy.

Length of body to anus (11903) 800 mm., (11904) 584 mm.; length of tail 122+ mm., 105 mm.; scale rows, 23, 24; ventrals, 231, 231; anal plate divided in both; pairs of caudals, 55+, 65; supralabials, 8, 8; infralabials, 13, 13; preoculars, 3, 3; postoculars, 3, 3; body spots, 20, 31; tail spots, 10+, 16. Both of these specimens come close to the average for this species as defined by Klauber (1928, p. 191).

Crotalus atrox Baird and Girard

Las Palmas Cañón: 10728–29; October 28 and 30, 1927.

The first individual was lying on a bare spot of ground. It started rattling when the collector was still twenty feet away from it and on the opposite side of a clump of bushes. The other one was nearly stepped on as it lay asleep in a trail. When disturbed it rattled vigorously, raising its head about a foot above the ground.

Crotalus cerastes Hallowell

San Felipe: 9563–67, 9629; March 26 and 29, and April 12, 17 and 30, 1926.

Two of these snakes were found coiled on sand dunes; one was run over in a road by an automobile. Two were found, March 26, lying together on the open desert.

Crotalus enyo (Cope)

San Ignacio: 13795; July 28, 1931.
Almejas Bay, Santa Margarita Island: 13859; June 13, 1931.
Eureka: 11922; August 23, 1929.
Todos Santos: 11919–20; October 16 and 25, 1928.
Miraflores: 11921; November 15, 1928.

The specimen taken on October 16 was found curled in grass near a marsh.

Crotalus lucasensis Van Denburgh

Yrais: 13794; May 13, 1931.
Eureka: 11917–18; August 22 and 23, 1929.
Todos Santos: 11912–14; October 14, 16 and 17, 1928.
Santa Anita: 11915; April 25, 1929.
Agua Caliente: 11916; June 6, 1929.

Crotalus confluentus mitchellii (Cope)

Santo Domingo, latitude 25° 30′: 13793; May 4, 1931.
Agua Caliente: 11923; June 25, 1929.
Todos Santos: 11924; October 16, 1928.
San José: 9814; May 7, 1925.

Crotalus confluentus oreganus Holbrook

South Island, Los Coronados Islands: 5404; July 4, 1913.
San Quintín, San Pedro Mártir region: 9817; June 17, 1925.
Socorro: 13857; March 13, 1931.

Crotalus ruber (Cope)

San Telmo: 9815–16; April 3, 1925.
El Cajón Cañon: 9638–39; May 21 and 22, 1926.
Santo Domingo: 9888; September 25, 1925.
Seventeen miles northwest of Calmallí: 13858; March 26, 1931.
San Ignacio: 10681; April 11, 1927.

The two snakes from San Telmo, found together on April 3, 1925, measured 1330 mm. and 1130 mm. in total length, measured in the flesh. The following comments were written down by the collector (Borell) at the time of capture of these snakes. "I came upon a pile of rattlesnakes about 15 feet ahead of me between two clumps of green brush. I stopped short and in a moment saw two heads moving in the mass of coils. Suddenly the two snakes started up the bank, crawling side by side and crowding each other. I shot and killed them both. I believe that they were mating, at least they were courting. Both snakes were very red. The soil in the cañon is red adobe."

At El Cajón Cañon a rattlesnake found on May 21 was killed on a rock under a mesquite tree near a brushy thicket between two streams. Toward evening of the next day a second one was killed about 20 yards from this place in a large mesquite thicket. The mesquite and arrowweed thicket here was quite dense, with a few narrow trails leading through it, and contained some large flat rocks and some cactus.

The snake found on September 25, seven miles north of Santo Domingo, was in the middle of the road at 100 feet altitude. It was partly coiled in the sunshine and was rather lethargic. It did not rattle even when teased, and did not strike until it was shot. Its length, relaxed, to base of rattles, was about 44 inches (1130 mm.).

Clemmys marmorata (Baird and Girard)

El Valle de La Trinidad: 10494; December 11, 1926.
San Telmo: 9818–19; June 17, 1925.

These specimens, recorded by Storer (1930, p. 429), extend the range of this turtle southward at least to the San Pedro Mártir region of Lower California. The specimen from the first listed camp which was at 2500 feet altitude, latitude 31° 21′, was found in sandy soil above the bank of a creek. The turtles from the southernmost locality at latitude 31° were taken from San Telmo Creek at 600 feet altitude. These were the only ones seen in that region below Valladares at 2700 feet altitude.

On April 22, 1927, Mr. Lamb recorded in his notebook that he "saw several mud turtles" in one of four ponds in the neighborhood of San Ignacio (lat. 27° 17′). No specimens of turtles were obtained at this station so the identification cannot be made certain. San Ignacio is nearly three hundred miles south of the southernmost definitely recorded station for *Clemmys marmorata*.

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AN UNRECOGNIZED SHREW FROM NEW JERSEY

BY

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AN UNRECOGNIZED SHREW FROM NEW JERSEY

BY

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Among shrews collected by myself from points as far apart as North Carolina and northern Manitoba, and Nova Scotia and British Columbia, a novelty is found, oddly enough, in a shrew from a locality only sixty miles from Philadelphia where, years ago, Audubon, Bachman, George Ord, and others pioneered in American mammalogy.

Sorex cinereus nigriculus, new subspecies

New Jersey Coast Shrew

Type specimen.—Adult, sex in question, skin and skull; no. 51413, Mus. Vert. Zool.; December 23, 1930; collected by Morris M. Green; original no. 154, of shrew collection of Morris M. Green.

Type locality.—Alluvial tidewater marsh on Tuckahoe River, east of Tuckahoe, Cape May County, southern New Jersey.

Diagnosis.—Skull and general size as in *Sorex cinereus cinereus* from northern Manitoba, but color very much darker.

Color.—Winter pelage blackish-plumbeous above and lighter plumbeous below; tail and feet dark brown. The color pattern is similar to that of a winter (December 28) specimen of the littoral marsh shrew, *Sorex bendirii palmeri*, from Tillamook, on the coast of Oregon, except that *nigriculus* is darker (less plumbeous) above.

Dimensions (in millimeters).—The type specimen and a topotype, no. 174, Morris M. Green shrew collection, measure, respectively, as follows: Total length, 101, 92; tail vertebrae, 43, 41; hind foot, 12, 12; condylobasal length, 16.1, 16.3; cranial breadth, 7.3, 7.6.

Comments.—When first obtained, the type specimen of the new form was regarded merely as a melanistic individual of *Sorex cinereus cinereus*, the only species of *Sorex* known to occur in southern New Jersey. It was not until February 17, 1932, that a second specimen was taken in the tidewater marsh. It, too, was blackish and indicated the existence there of the race now described.

The type locality of the new form is very near the southern limit of the Atlantic, salt-water, littoral range of the species *Sorex cinereus*. Apparently a warm humid environment has modified this shrew as it

has the land vole, ***Microtus pennsylvanicus nigrans,*** in the Albermarle Sound region of North Carolina. Also from the salt marshes of the San Francisco Bay region, California, there have been named (Grinnell, Univ. Calif. Publ. Zool., **10**, 1913, pp. 179–195) two, extremely dark colored kinds of shrews, *Sorex vagrans halicoetes* and *Sorex sinuosus.*

Specimens of *Sorex cinereus* taken by me in winter on the light-colored, sandy soil of the island beaches farther north, at Beach Haven and Seaside Park, New Jersey, are not of the dark race, *nigriculus.*

Transmitted April 22, 1932.

A RELIC SHREW FROM CENTRAL CALIFORNIA

BY

JOSEPH GRINNELL

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A RELIC SHREW FROM CENTRAL CALIFORNIA

BY

JOSEPH GRINNELL

(Contribution from the California Museum of Vertebrate Zoology)

The race of shrew here newly named is thought to have been widely resident under earlier conditions, in the swampy margins of Kern, Buena Vista, and Tulare lakes, in the bottom of the upper (southern) portion of the San Joaquin Valley, California. The beds of those former lakes, which had doubtless been of long existence through physiographic time, are now dry and for the most part under close cultivation, and only meager remnants of the original palustrine fauna are to be found. Indeed, there is reason to believe that most of the vertebrate animals restricted to that area of once stagnant waters have become altogether extinct there within the last fifty years. Almost the entire palustrine fauna has vanished as a result of man's activities in diverting the intrant streams for irrigation. The shrew here named is a relic of that fauna.

Sorex ornatus relictus, new subspecies

Buena Vista Lake Shrew

Type specimen.—Adult female, skin and skull; no. 51414, Mus. Vert. Zool.; excavated slough immediately outside of east side levee, Buena Vista Lake, 290 feet altitude, Kern County, California; February 26, 1932; collected by Ward C. Russell; orig. no. 1992.

Diagnosis.—A shrew of the *Sorex ornatus* group (see Jackson, N. Am. Fauna, No. 51, 1928, p. 163). Differs from the nearest geographic race of that group, *S. o. ornatus*, whose range nearly surrounds that of the new form, as follows: Coloration distinctly darker, grayish black, rather than brown; body size slightly larger, but tail shorter; skull with rostrum shorter and heavier, and with brain-case decidedly higher, and more angular in dorsal view; teeth essentially as in *ornatus*, but third and fifth unicuspids apparently even smaller relatively to the other teeth.

Measurements.—The type, and two cotypes (nos. 51416 ♀, 51415 ♂, taken at the type locality by W. C. Russell, February 27, 1932), give dimensions in millimeters as follows. The first four dimensions are as taken by the collector. Total length, 98, 99, 105; tail, 39, 35, 39; hind foot, 12, 11.5, 13; ear from notch, 7, 6.5, 8.5; condylobasal length, 16.4, 16.3, 17.0; palatal length, 6.5, 6.4, 6.8; cranial breadth, 8.1, 8.2, 8.2; greatest height of cranium, 4.9, 5.0, 5.2; interorbital breadth, 3.3, 3.4, 3.4; maxillary breadth, 4.8, 5.0, 4.9; maxillary tooth row, 5.8, 5.7, 5.9. Weights, 5.3, 4.1, and 7.6 grams, respectively. (Measurements of skull taken as described by Jackson, *loc. cit.*, p. 13.)

Color.—Upper surface (using color terms from Ridgway's *Color Standards and Color Nomenclature,* 1912) in general effect blackish clove brown; closer inspection discloses a pepper-and-salt pattern, buffy brown and black, the latter predominating; sides broadly lighter-toned, that is, with a much greater proportion of buffy brown in the color mixture; lower surface smoke gray with a slight wash of drab; tail blackening toward end, both above and below, not notably bicolor, save that there is a paling ventrally toward base. The type and no. 51415 are alike in color; no. 51416 is much the blacker above, but is of the same tint below as the others.

Comments.—Marsh inhabitation appears frequently to have induced darkening in coloration of both birds and mammals as compared with near-related upland races. This is illustrated in California in shrews of the *vagrans-obscurus* group as well as in the *ornatus* group. In the latter group, the black-colored *Sorex sinuosus* of the Suisun marshes is a farther departure in this direction than is *relictus.* These two forms, however, differ conspicuously in that the lower surface of *sinuosus* is very much the darker, hair brown to chaetura drab, rather than smoke gray; also there are marked cranial differences in that the brain-case of *sinuosus* is low and flat-topped; *relictus* shows the highest brain-case in its group.

While the only specimens of good *relictus* at hand are the three from the type locality, the range of the form can be conjectured to include, or to have once included, the marshlands of the upper floor of the San Joaquin Valley south from about where the waters of the Kings River divide toward the San Joaquin River and toward the bed of Tulare Lake, respectively. A comment of Jackson's (*loc. cit.*, p. 167) has significance in this regard: "Specimens from Summit Lake, California [north of Tulare Lake, in Fresno County, at about the highest point in the Kings River delta of distributaries], collected June 27, 1907, are darker than normal specimens of *S. o. ornatus*. . . . ." Elsewhere, these same specimens are commented upon as having "a trifle shorter tails." Two specimens in the Museum of Vertebrate Zoology from the Kern River near Bakersfield show slight darkening of color, thus toward the condition in *relictus,* and the skulls show similarities. The range of *ornatus,* which is for the most part an upland streamside animal, very nearly surrounds the range of *relictus;* the above evidence points toward intergradation along the lower courses of the streams which enter the Kern-Tulare evaporation basin.

Transmitted April 22, 1932.

NEW MAMMALS FROM ST. LAWRENCE ISLAND, BERING SEA, ALASKA

BY

E. RAYMOND HALL AND RAYMOND M. GILMORE

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NEW MAMMALS FROM ST. LAWRENCE ISLAND, BERING SEA, ALASKA

BY

E. RAYMOND HALL AND RAYMOND M. GILMORE

(Contribution from the Museum of Vertebrate Zoology of the University of California)

In the spring of 1931, Miss Annie M. Alexander decided to carry further the study of Alaskan birds and mammals begun by her in 1907, a decision made possible through the willingness of officials of the United States Coast Guard Service to permit a representative of the Museum of Vertebrate Zoology to go northward with, and return on, the Coast Guard Cutter "Northland." The junior author was employed to carry out this work, which involved visits to several parts of Alaska where the vertebrate fauna was incompletely known.

One of these places was St. Lawrence Island, where, with Mr. Herbert L. Mason, who was working under the auspices of the Carnegie Institution of Washington, he was set ashore at Sevoonga, on June 22, 1931. Collecting was carried forward on the Island until July 12, 1931, when the "Northland" was again boarded and her course directed by Commander Edward D. Jones to other parts of Alaska.

Of land mammals, five kinds were obtained on St. Lawrence Island and a sixth, the Arctic fox, was seen. So far as we know, specimens of the Arctic fox, genus *Alopex*, from St. Lawrence Island have not been critically studied, or reported upon. We have therefore no basis for venturing an opinion as to whether it belongs to the species that occurs on one or the other of the two adjacent continental land masses, or is perhaps a species restricted to St. Lawrence Island.

Each of the five other species, of as many genera, is limited to St. Lawrence Island but, as does the Arctic fox, belongs to a genus of circumpolar distribution in the Boreal Zone. It is difficult to say whether or not the land mammal fauna of the island as a whole shows greater affinity with that of Asia or with that of North America. The *Citellus* appears to have its nearest relative on the Asiatic side of the Strait; the *Sorex* seems to be more closely related to North American forms; and each of the three microtines appears to have near relatives both in Asia and North America.

Two of the mammals on St. Lawrence Island, the meadow mouse and the collared lemming, were already known to science. Three of the kinds obtained in 1931 proved to be unnamed species. The five species, together with the number of specimens obtained of each, are as follows:

Saddle-backed Shrew, *Sorex jacksoni*, new species	16
Ground Squirrel, *Citellus lyratus*, new species	7
Collared Lemming, *Dicrostonyx exsul* G. M. Allen	3
Red-backed Vole, *Clethrionomys albiventer*, new species	3
Meadow Vole, *Microtus innuitus innuitus* Merriam	35

Through the generosity of the Alaska Agricultural College and School of Mines as expressed by its President, Dr. Charles E. Bunnell, who instructed Mr. Otto Wm. Geist to supplement our St. Lawrence Island collection, we are able to add here an account of the heretofore unknown race of *Microtus* which occurs on Punuk Island. Punuk Island lies only a few miles off the eastern end of St. Lawrence Island. It was also through the efforts of Mr. Geist that a number of specimens of the species found on St. Lawrence Island were obtained.

Color terms employed in the following accounts are taken from Ridgway, "Color Standards and Color Nomenclature," 1912.

Sorex jacksoni new species

Plate 5, figures *a* to *f*

Type.—Female, adult, skin and skull; no. 51142, Mus. Vert. Zool.; Sevoonga, 2 miles east of North Cape, St. Lawrence Island, Bering Sea, Alaska; June 27, 1931; collected by Raymond M. Gilmore, original no. 1658.

Geographic range.—Known only from the type locality.

Diagnosis.—Coloration in summer pelage tricolor; total length of adults averaging 102 (extremes, 94–107); tail averaging 50 per cent (47 per cent–56 per cent) as long as head and body; third unicuspid tooth as large as, or larger than, fourth; infraorbital foramen with posterior border lying anterior to posterior border of m^1; condylobasal length more than 15 mm.; palate long (6.2–6.9); interpterygoid space short; molars longer than wide; unicuspids without pigment on medial cingula.

Color.—Summer pelage: Tricolor, the back sharply defined from sides, which are less clearly defined from the ventral parts. Top of head and back to and including proximal half of upper side of tail clove brown or near (*n*) clove brown; sides and narrow strip on each side of head between wood brown and avellaneous; underparts near smoke gray; tail bicolor, below near (*g*) light buff, above near (*n*) clove brown in proximal half and lighter (*bister*) in terminal half; feet, on fore and hind limbs, nearly white with pinkish tinge.

Time of molting.—Our thirteen skins all taken between June 27 and July 11 are in the summer pelage. However, each has a small tuft of winter pelage on the nose and five of the specimens have a few hairs of what seems to be the winter

coat, remaining on the tail. Judging from these traces of winter pelage it was cinnamon brown on the upper parts.

Skull.—Short and broad; rostrum long; mesopterygoid space short; brain case moderately flattened; dentition moderate; molariform teeth longer (antero-posterior diameter) than broad (extero-internal diameter); cusp-like processes of basal shelves of molariform teeth as in *Sorex cinereus streatori;* unicuspidate teeth relatively large and broad (extero-interior diameter), decreasing gradually in size posteriorly to the fifth which is less than a third as high as the fourth, though in occlusal view the fifth is only a little, if any, smaller than the fourth; internal ridge extending from apex of unicuspid toward cingulum weakly or not at all pigmented and ending in secondary cusplet on first three unicuspids; fourth unicuspid without mentioned secondary cusplet.

Comparison.—By comparison of the mentioned characters of *Sorex jacksoni* with those summarized by Jackson (1928) for related forms, it will be seen that our new species from St. Lawrence Island bears closest relationship to the Sorex arcticus group and the Sorex pribilofensis group. As compared with *Sorex pribilofensis,* the sole representative of its group, *jacksoni* is seen to average slightly greater in total length with a relatively shorter tail and actually smaller hind foot. The preorbital part of the skull is much longer in *jacksoni* as reflected by the measurements of palatal length and maxillary tooth row, though this part is actually narrower as shown by the maxillary breadth of only 4.4 as against 4.8 in *pribilofensis.* Also, to judge by Jackson's (*op. cit.*, p. 78) account and figures of *pribilofensis, jacksoni* is darker colored, has a deeper brain case, relatively longer molars, and less heavily pigmented unicuspids.

The geographically adjacent member of the Sorex arcticus group, *Sorex tundrensis,* averages larger in external measurements, and has a skull which is constantly larger, though of the same general proportions. However, in *jacksoni* the palate averages relatively a little longer and the cranial breadth averages relatively a little less.

The broad rostrum, tricolored coat in summer pelage, and a number of other characters differentiate the new species *jacksoni* from any of the northwestern races of *Sorex cinereus.*

None of the described shrews from northeastern Asia of which we have examined specimens or descriptions closely approaches the St. Lawrence Island species.

Remarks.—We take pleasure in naming this striking new species after Dr. Hartley H. T. Jackson, whose careful work, "A Taxonomic Review of the American Long-tailed Shrews," North American Fauna, no. 51, has given us a much improved basis for evaluating the relationships of the new forms of *Sorex* that, from time to time, come to light.

On the basis of morphological characters we judge our new species to stand between *Sorex pribilofensis* and *Sorex tundrensis.* On the whole it probably is more closely related to the latter and we therefore regard it as a member of the Sorex arcticus group.

We know of no previous mention in literature of this shrew unless it be by Jackson (*op. cit.* p. 56) who remarks that "A single skin without skull from St. Lawrence Island, Alaska, is provisionally

referred to *hollisteri*." *Sorex cinereus hollisteri* may of course be found to occur on the Island, though it seems probable that a re-examination of the skin mentioned by Jackson will show it to be of the species *Sorex jacksoni*.

All the sixteen specimens of *Sorex jacksoni* were taken in a mass of igneous rock, from 75 to 150 feet wide, which, on the seaward side, formed a cliff varying from 50 to 100 feet in height. This mass of jumbled boulders, mostly two to eight feet in diameter, extended for more than a half-mile along the edge of the Island, and constituted the driest, and for small mammals probably the safest, place in the vicinity. The only kinds of vertebrates other than *Sorex jacksoni* found to inhabit this rock mass were small numbers of *Clethrionomys albiventer*, *Citellus lyratus*, Crested Auklets, and large numbers of Least Auklets. Consistent trapping on the wet tundra, along the creeks and beach, and a substantial standing reward for any shrew brought in, yielded no specimens of this animal. Thus, it seems that *Sorex jacksoni* was, at the time of our trapping, limited to the rocks. The natives state, however, that in winter these shrews invade the meat-houses in the village.

The part of Jackson's key which would require modification to include *Sorex jacksoni* involves lines 12 to 21 (Jackson, 1928, p. 32) inclusive. This part of the key might now stand as follows:

d^1. Maxillary breadth not more than 4.6.
  e^1. Condylobasal length 15 or more.
    f^1. Palatal length 6.2 or more; maxillary tooth row usually more than 5.7.
      g^1. Color of back sharply darker than sides; coloration tricolor in summer pelage; tail less than 38.......................................**jacksoni**
      g^2. Color of back not sharply darker than sides; coloration bicolor in summer pelage; tail more than 38.
        h^1. Color more grayish; cranial breadth 8 or more; geographic range northeastern coast region of North America......**miscix** (p. 50)
        h^2. Color more brownish; cranial breadth less than 8; geographic range northwestern coast region of North America..**streatori** (p. 53)

We have been unable to duplicate Jackson's (*op. cit.*) measurements of palatal length. On specimens for which he records measurements, we obtain ones ranging from one-tenth to four-tenths of a millimeter greater. On this account we suspect that measurements of our new species, if taken by Jackson, would vary accordingly. In that case, many of the specimens of *Sorex jacksoni* would not fit in the above modified section of the key, but would key down to line 27.

To provide for these, the following lines, modeled after preceding ones in the original key, may be inserted between lines 28 and 29.

i¹. Known geographic range confined to St. Lawrence Island, Alaska .... **jacksoni**

i². Known geographic range not including St. Lawrence Island, Alaska

The succeeding, indented lines, 29 and 31, of Jackson's (*op. cit.*) original key would, with substitution of the above, bear key headings j¹ and j².

A word of explanation is in order as to the taking of the measurement designated by us as "least interorbital breadth." This measurement, as taken by us, is not the same as Jackson's (*op. cit.*) "interorbital breadth." His measurement was taken at some point behind the greatest constriction and on any given skull is greater than our measurement of least interorbital constriction which, in *Sorex jacksoni*, amounts to the distance from the dorsal margin of the posterior opening of one infraorbital canal to its opposite.

Specimens examined.—Sixteen, from the type locality, as follows: 12 skins-with-skulls; 1 skin-only; 2 skulls-only; 1 complete skeleton.

Measurements, in Millimeters, of the Type and Fourteen Topotypes of *Sorex jacksoni*

Excepting the "least interorbital breadth," and possibly "palatal length," all measurements taken as by Jackson (1928, p. 13). Each specimen has the teeth slightly worn.

Catalogue number	Sex	Total length	Length of tail	Length of hind foot	Condylobasal length	Palatal length	Cranial breadth	Least interorbital breadth	Maxillary breadth	Maxillary tooth-row
51143	♂			13	15.8	6.4	7.8	2.8	4.5	5.8
51146	♂	102	34	13			8.0			
51150	♂			13	16.0	6.4	7.8	2.8	4.5	5.8
51152	♂	105	36	13	16.0	6.4	7.8	2.8	4.3	5.8
51157	♂	99	32	12						
51153	♂	94	32	13	15.9	6.5	7.9	2.9	4.4	5.8
51156	♂	100	36	14	16.1	6.3	8.1	2.9	4.5	5.8
51148	♂	97	34	12	15.1	6.2	7.7	2.7	4.3	5.7
51154	♂	104	37	13	15.8	6.9	7.6	2.8	4.4	5.8
51147	♀	107	34	13	16.1	6.6	7.5	2.9	4.4	5.9
51142	♀ (type)	104	35	12	15.9	6.4	7.7	2.9	4.5	5.8
51144	♀	99	33	12	16.0	6.5	7.8	2.8	4.5	5.9
51145	♀	106	37	13	16.3	6.3	7.8	2.9	4.6	5.9
51151	♀	105	34	12	15.6	6.3	7.8	2.8	4.4	5.7
51155	♀	101	33	13	15.6	6.4	7.5	2.8	4.5	5.8
Average of 15		102	34.4	12.7	15.9	6.4	7.8	2.8	4.4	5.8

Citellus lyratus new species

Plate 6, figures *e* and *f*

Type.—Male adult, skin and skull; no. 51172, Mus. Vert. Zool.; Iviktook Lagoon [on coast about fifteen miles west of Northeast Cape], St. Lawrence Island, Bering Sea, Alaska; July 7, 1931; collected by Raymond M. Gilmore; original no. 1738.

Geographic range.—Known only from St. Lawrence Island, Bering Sea, Alaska.

Diagnosis.—Size: Small (see measurements). Color: In fresh July pelage, back black and russet with small white spots; nose and forehead russet; sides lighter without distinct spotting; underparts gray with wash of light cinnamon which extends over shoulders, sides of neck, throat and onto fore limbs; chin and medial sides of hind legs whitish; hind feet lighter, near pinkish buff; tail russet below with tricolored (black, brown and white) hairs above, with black band on hairs becoming widest at tip of tail. In worn June pelage similar but lighter; pallid mouse gray of under fur prominently showing; spotting of back indistinct or absent; underparts pallid mouse gray or tinged with tawny olive. Skull: Small; temporal ridges lyrate, not forming a sagittal crest and not meeting posteriorly except in specimens of extreme age; lambdoidal crest, supraorbital ridges and postorbital processes weakly developed; palatal spine strongly developed; skull narrow; teeth small; sphenopalatine vacuities small; zygomatic processes of maxillae not widely spreading; inferior margin of foramen magnum with deep U-shaped indentation; nasals not extending as far posteriorly as premaxillae and with anterior border protruding far forward at median line; anterior lip of external auditory meatus curved forward.

Comparisons.—Of described forms of *Citellus*, *C. buxtoni* J. A. Allen most closely approaches *C. lyratus*, which differs constantly from *C. buxtoni*, as represented to us by seven specimens from Emma Harbor, Gulf of Anadir, Siberia, in having shorter, weaker postorbital processes and in possessing sphenopalatine vacuities which are shorter and narrower. Also, on the average, the skull of *C. lyratus* is narrower, relatively as well as actually, especially across the zygomatic arches and in the interorbital region; the interorbital notches have the posterior borders less well developed or even absent; anteriorly the zygomatic arches spread less abruptly and less widely; the tooth rows are relatively as well as actually shorter by .5 of a millimeter; the palatal spine is always present rather than poorly developed or absent; and the temporal ridges unite posteriorly at a slightly greater age.

The type is in fresh summer pelage and closely resembles individuals of *C. buxtoni* taken in August, save that in *lyratus* the back is somewhat lighter, the cinnamon of the hind legs less intense, and the areas of russet on the nose and underside of the tail are less extensive. We have no individuals of *C. buxtoni* which display as much wear on the pelage as do most of our specimens.

External measurements taken by the collectors on both forms indicate that *C. lyratus* is but slightly, if any, smaller than *C. buxtoni*.

Of North American forms, *Citellus plesius ablusus* of the Bristol Bay region probably comes closest in morphological characters to *Citellus lyratus*. The two are of similar size but as compared with specimens of *ablusus* from Unalaska,

lyratus is seen to differ as follows: Slightly less russet in summer pelage; temporal ridges lyrate rather than slanting back from the postorbital processes with but slight curvature and meeting posteriorly only in oldest individuals rather than uniting to form sagittal crest along posterior third or half of brain case; premaxillae extending several millimeters posteriorly to nasals rather than ending on same line with nasals; jugo-squamosal parts of zygomatic arches parallel instead of converging anteriorly; notch in ventral border of foramen magnum U-shaped rather than V-shaped; palate terminates nearer end of maxillary tooth-row, and brain case wider though skull slightly narrower interorbitally.

As compared with specimens of *Citellus beringensis* from Point Hope, Alaska, *C. lyratus* is constantly smaller and has much less ochraceous buff coloration. Other differential features of *lyratus* are as follows: Skull less angular, less ridged, and less massive; temporal ridges lyrate and barely meeting posteriorly rather than uniting to form a sagittal crest; sphenopalatine vacuities much smaller; zygomatic arches less expanded; supraorbital and lambdoidal crests lower.

Remarks.—On St. Lawrence Island, *Citellus lyratus* was scarce at the time our specimens were taken. The individuals noted were inhabiting sandy, rocky or drier tundra-covered parts of the terrain along the northern coast. None was found on marshy ground or particularly wet tundra where, probably, it was too damp for them to build comfortable burrows.

An immature specimen, taken September 25, 1931, has darker, less spotted, pelage than June- and July-taken adults. Also, the sphenopalatine vacuities are larger in the immature animal.

At first glance adult skulls of *lyratus* strongly resemble immature skulls of *C. p. ablusus* due to the peculiar configuration of the temporal ridges and the general weaker construction of the skull.

Specimens examined.—Total number, 7, all from St. Lawrence Island, Bering Sea, Alaska, as follows: Iviktook Lagoon, type locality, 2; Sevoonga, 3; Naskook Lagoon [about ten miles east of Cape Chibukak], 2.

MEASUREMENTS, IN MILLIMETERS, OF FIVE SPECIMENS OF *Citellus lyratus*

Catalogue number	Sex and age	Total length	Length of tail	Length of hind foot	Greatest (Condylo-nasal) length	Basilar length	Palatal length	Zygomatic breadth	Least interorbital breadth	Postorbital breadth	Cranial breadth	Length of nasals	Alveolar length of maxillary tooth-row
51170	♂ ad	350	97	58	57.3	48.1	31 8	36.1	12.6	13.7	22.3	20.3	12 1
51172	♂ad(type)	381	114	54	57.9	47.6	32.4	36.5	12.4	13.4	22.7	20.8	12.0
51171	♂ ad			60	57 9	47.5	32 1	35.9	12.7	13.6	22.4	21.0	12.4
51173	♀ ad	379	111	57	57.2	47.0	31.5	35.0	12.3	13.0	22 3	20.6	12.4
51174	♀ ad								12 3			19.9	11.9

Clethrionomys albiventer new species

Plate 6, figures *a* and *b*

Type.—Female adult, skin and skull; no. 51221, Mus. Vert. Zool.; Sevoonga, two miles east of North Cape, St. Lawrence Island, Bering Sea, Alaska; June 27, 1931; collected by Raymond M. Gilmore; original no. 1660.

Geographic range.—Known only from the type locality.

Diagnosis.—Size: Large (see measurements). Coloration: Pale; dorsal stripe well defined, Sudan brown; sides gray, lacking buff; feet and belly clear pale olive gray; tail sharply bicolor, gray below, Sudan brown above; post-auricular patch gray. Skull: Large; anterior palatine foramina constricted posteriorly; foramen magnum small; frontals with slight postorbital depression.

Remarks.—This large, pale colored species from St. Lawrence Island, though equal in size to specimens of the Old World *Clethrionomys rufocanus* and its allies, differs from that group in having four rather than three salient angles on the inside of $m^{\underline{2}}$, as well as in other respects, and more nearly resembles forms of the *rutilus* group as defined by Hinton (1926, p. 213).

Fig. 1. Enamel pattern, × 9, of *Clethrionomys albiventer*, new species. Type specimen, female adult; no. 51221, Mus. Vert. Zool.; Sevoonga, two miles east of North Cape, St. Lawrence Island, Bering Sea, Alaska; June 27, 1931; collected by Raymond M. Gilmore; original no. 1660.

a. Right upper molars. *b.* Right lower molars.

Drawings are photographically accurate. Outlines were made on photograph; photograph then washed out.

Employing Hinton's (*op. cit.*) published accounts of *Clethrionomys rutilus* and other forms in the same group, it is apparent that *C. albiventer* is larger throughout and lighter colored. In comparison with topotypes of *Clethrionomys rutilus jacutensis, C. albiventer* has the palatal bridge less complete and the anterior, outer re-entrant angle of $m^{\underline{2}}$ shallower. Also, our specimens of *albiventer*, which, even though taken in late June and early July, appear to be in winter pelage, are even lighter colored than one January-taken topotype of *C. r. jacutensis.* Vinogradov (1927, p. 17) regards winter specimens of this race taken in the wild as "remarkably pale." However, our winter specimen (see Vinogradov, *op. cit.*) may have been taken in a human dwelling and therefore darker than the winter specimens taken in the wild.

As compared with *Clethrionomys dawsoni dawsoni* of the adjacent mainland of North America, *C. albiventer* is larger, lighter colored and has more densely haired feet. Other differential features of *albiventer* are as follows: Skull less depressed interorbitally; tympanic bullae larger; foramen magnum averaging smaller; paroccipital processes more pronounced; palatine foramina constricted posteriorly rather than straight.

All specimens obtained of *Clethrionomys albiventer* were taken in the same mass of boulders where the shrews were taken (see p. 394). The *Microtus innuitus innuitus* which one might expect to find associated with *Clethrionomys albiventer*, though everywhere abundant over the tundra, were absent among the rocks. Even here *Clethrionomys* was scarce, even scarcer than the shrews; four hundred trap-nights in the rocky area yielded only three *Clethrionomys* and sixteen *Sorex.*

Speimens examined.—Three from the type locality.

MEASUREMENTS, IN MILLIMETERS, OF THE TYPE AND TWO TOPOTYPES OF *Clethrionomys albiventer*

Catalogue number	Sex and age	Total length	Length of tail	Length of hind foot	Condylobasal length	Basal length	Palatal length	Length of nasals	Least interorbital breadth	Zygomatic breadth	Occipital breadth	Interorbital breadth
51221	♀ ad (type)	153	34	21	26 6	24 9	13 9	8 3	4 6	14 5	12 6	4 6
51222	♀ ad	150	31	21	26 9	25 2	14 1	8 0	4 8	14 7	12 7	4 8
51223	♂ ad (very old) .	152	37	20	27 1	25 5	14 2	8 0	4 5	14 5	12 9	4 5

Microtus innuitus punukensis new subspecies

Plate 6, figure *c*

Type.—Female, adult, skin and skull; no. 51392, Mus. Vert. Zool.; Big Punuk Island [near east end of St. Lawrence Island], Bering Sea, Alaska; August 19, 1931; collected by Otto Wm. Geist, original no. 2330 R. M. Gilmore.

Range.—So far as known confined to Big Punuk Island, Bering Sea, Alaska.

Diagnosis.—Coloration and apparently size as in *Microtus innuitus innuitus;* skull large with supraoccipital vertical and with anterior border of interparietal -shaped.

Comparisons.—From its near relative, *Microtus innuitus innuitus* of St. Lawrence Island, *M. i. punukensis* differs in having the supraoccipital vertical rather than strongly inclined forward and in that the anterior border of the interparietal is -shaped rather than Λ-shaped.

Remarks.—The honor of discovering this new meadow mouse goes to Mr. Otto Wm. Geist who, working under the direction of Dr.

Charles E. Bunnell, President of the Alaska Agricultural College and School of Mines, forwarded the specimens, along with others, to the University of California in order to supplement the collections made by the junior author on St. Lawrence Island.

Of *Microtus innuitus innuitus* which was originally described only from skulls and other skeletal material taken from pellets regurgitated by birds, we have thirty-five skins with skulls. The youngest members of this lot are females which carried embryos. Measurements of total length range from 163 to 220. Other, average and extreme, measurements are as follows: Length of tail, 36.1 (30–48); length of hind foot, 22.2 (21–24). These specimens and those of *M. i. punukensis* lack the buff, or yellowish, color of *Microtus abbreviatus fisheri* and are bluish white below and reddish brown above, the general effect being about as in *Microtus unalascensis unalascensis.*

The differences between *Microtus innuitus innuitus* of St. Lawrence Island and *Microtus innuitus punukensis,* in so far as made out by us, are constant. That is to say, individual variation—and it may be added, age variation—has not been found to bridge the gap separating the two. On this account it might be argued that *punukensis* should be accorded full specific rank. However, it should be remembered that the differences, though constant, are relatively slight and that the two forms are far more like one another in morphological features than either is like any other form.

Specimens examined.—Twenty-one specimens from the type locality.

MEASUREMENTS, IN MILLIMETERS, OF THE TYPE AND FOUR TOPOTYPES OF *Microtus innuitus punukensis*

Catalogue number	Sex and age	Total length	Length of tail	Length of hind foot	Basal length	Length of nasals	Zygomatic breadth	Mastoid breadth	Alveolar length of upper molar series
51392	♀ ad (type)	196	40.5	22.5	30.2	9.5	18.4	14.0	7.7
51391	♀ ad	179	36.0	22.5	29.3	9.0	17.7	13.4	7.2
51390	♀ ad	183	36.5	23.0		8.5		13.1	6.8
51408	♀ ad	166	33.0	20.0	27.4	8.9	16.8	13.0	6.8
51410	♀ ad	162	37.0	21.0	28.0	8.6	16.4	13.1	7.0
Average of 5 ad ♀♀		177	37.0	21.8	28.8	8.9	17.3	13.3	7.1

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Transmitted March 21, 1932.

EXPLANATION OF PLATE 5

Photographs of the skull of *Sorex jacksoni*, type, female adult; no. 51142, Mus. Vert. Zool.; Sevoonga, two miles east of North Cape, St. Lawrence Island, Bering Sea, Alaska; June 27, 1931; collected by Raymond M. Gilmore; original no. 1658.

a.	Dorsal view,	× 1.	*d.*	Lateral view,	× 6.
b.	Ventral view,	× 1.	*e.*	Dorsal view,	× 6.
c.	Lateral view,	× 1	*f.*	Ventral view,	× 6.


a
b
c
d
e
f

EXPLANATION OF PLATE 6

Photographs of rodent skulls from islands in Bering Sea, Alaska.

a. Clethrionomys albiventer, dorsal view, × 2, of type, female adult; no. 51221, Mus. Vert. Zool.; Sevoonga, two miles east of North Cape, St. Lawrence Island, Bering Sea, Alaska; June 27, 1931; collected by Raymond M. Gilmore; original no. 1660.

b. Clethrionomys albiventer, ventral view, × 2, of same specimen shown in *a*.

c. Microtus innuitus punukensis, dorsal view, × 2, of type, female adult; no. 51392, Mus. Vert. Zool.; Big Punuk Island [near east end of St. Lawrence Island], Bering Sea, Alaska; August 19, 1931; collected by Otto Wm. Geist; original no. 2330 R. M. Gilmore. Note, in comparison with *M. i. innuitus*, shown in *d*, the vertical rather than anteriorly inclined supraoccipital and the outline of the anterior margin of the interparietal. Each of these differences serves constantly to differentiate individuals of one form from those of the other.

d. Microtus innuitus innuitus, dorsal view, × 2, of male adult; no. 51255, Mus. Vert. Zool.; Sevoonga, two miles east of North Cape, St. Lawrence Island, Bering Sea, Alaska; June 23, 1931; collected by Raymond M. Gilmore; original no. 1616A.

e. Citellus lyratus, dorsal view, × 1, of type, male adult; no. 51172, Mus. Vert. Zool.; Iviktook Lagoon [on coast about fifteen miles west of Northeast Cape], St. Lawrence Island, Bering Sea, Alaska; July 7, 1931; collected by Raymond M. Gilmore; original no. 1738.

f. Citellus lyratus, ventral view, × 1, of same specimen shown in *e*.


a
b
c
d
e
f

A NEW LAKE-SIDE POCKET GOPHER FROM SOUTH-CENTRAL CALIFORNIA

BY

JOSEPH GRINNELL

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London, England

A NEW LAKE-SIDE POCKET GOPHER FROM SOUTH-CENTRAL CALIFORNIA

BY

JOSEPH GRINNELL

(Contribution from the University of California Museum of Vertebrate Zoology)

Twelve specimens of pocket gophers (nos. 51421–32, Mus. Vert. Zool.) collected by Mr. Ward C. Russell and the writer, February 26 and 27, 1932, in the basin of Buena Vista Lake, in Kern County, California, give prime basis for naming the following described race. This subspecies is characterized among other things by remarkably large size; indeed, it is the largest in the entire *Thomomys bottae* group of races. Its range comprises portions of the floor of the former Buena Vista Lake, which lake was originally maintained chiefly by the intrant waters from the Kern River. With the construction of extensive systems of irrigation canals and dikes, these waters no longer reach the lake bed, at least they do not do so in sufficient volume to fill the lake basin to its former maximum level such as resulted in overflow through Buena Vista Slough toward the Tulare Lake basin, now dry also. A marginal lacustrine area of original distribution is indicated for this subspecies, remindful of that of *Thomomys operarius* Merriam around Owens Lake, in Inyo County, California, and that of *Thomomys relictus* Grinnell around Honey Lake, in Lassen County, California.

Thomomys bottae ingens new subspecies

Buena Vista Lake Pocket Gopher

Type.—Old adult male, in full breeding condition, skull and skin; no. 51421, Mus. Vert. Zool.; east side levee, 290 feet altitude (2 miles due west of Millux, as shown on U. S. G. S. "Buena Vista Lake Quadrangle"), Buena Vista Lake, Kern County, California; February 26, 1932; collected by J. Grinnell; orig. no. 7065, J.G.

Diagnosis.—A *Thomomys* of the "bottae group," this as defined by Bailey (U. S. Dept. Agr., N. Am. Fauna, No. 39, 1915, pp. 33, 45–63). Size large, exceeding that of any heretofore discovered race in that group, and even approaching closely in this respect to *nevadensis* of the

"townsendii group"; fore claws notably longer or heavier than in other members of the bottae group, at all the ages represented in the 20 skins at hand; general coloration moderately dark, somewhat as in *T. bottae bottae* (Eydoux and Gervais) but duller, less warmly brown; decidedly darker, duller, less brightly tawny or ochraceous than in *T. b. pascalis* Merriam, *T. b. angularis* Merriam, or *T. b. infrapallidus* Grinnell; a considerable amount of white shows irregularly and asymmetrically about the face and on the belly, wrists, and ankles on different specimens; skull heavy-boned, wide, and angular; rostrum notably heavy, more so than in any of the races just named; auditory bullae greatly swollen, distinctly larger even than in *pascalis*; teeth large, even relatively, and incisors slightly more forward-projecting than in the neighboring races. [For illustration of most of these characters, see pl. 7.]

Distribution.—So far as indicated by material at hand, only the bed of the Buena Vista Lake "sink," east of its deepest place, where now for the most part diked, irrigated, and cultivated. Specimens examined, 20: 12 from the type locality as above and 8 (nos. 28288–95, Mus. Vert. Zool.) from a locality given on the labels "12 mi. S., 8 mi. W. Bakersfield." These were collected May 3 and 4, 1918, by Joseph Dixon and Halsted G. White; recourse to the field notebooks of these collectors shows that this place was on alfalfa lands, at 300 feet altitude, just two miles north of the railroad station called Conner, and thus about seven miles due east of the type locality of *ingens*.

Measurements.—See accompanying table; comparisons should be made with the many figures given by Bailey (*loc. cit.*).

Variations.—The accompanying table of measurements gives a partial indication of the extent of cranial variation. With the whole series of 20 skulls before me, I am impressed with the extreme difference in size attained with age between the sexes. The largest female skull (no. 51430) weighs, with mandible, air dry, 4.8 grams: the largest male, handled similarly, 9.3 grams, thus nearly twice as much. A "middle-aged" female skull with mandible (no. 51429) weighs 4.1 grams; a "middle-aged" male skull (no. 51424), 6.3, only 50 per cent greater. It is thus clear that males as regards growth are less conservative than females; and this is borne out by the gross aspect of the series of skulls—the females are far more uniform in size than the males. Not only is this uniformity apparent as regards size, but it pertains conspicuously also to degree of angularity and ridging. This is, of course, a well-known phenomenon in the genus *Thomomys*, with varying amount of difference from little (almost none in some species) to great; but the race now described looks to me to exhibit it in most extreme degree.

As I have elsewhere suggested (Univ. Calif. Publ. Zool., **38**, 1931, p. 4) the most logical course under the above circumstances would be to select, in this genus, only females as type specimens. I would have done this in the present instance, except for the reason that all other types designated in the "bottae group" (as defined by Bailey, *loc. cit.*) have been males. Even so, I select for typeship, not the largest, "overgrown" male in the series, but the specimen that is nearer "middle-aged" and hence shows the true systematic characters, those which I believe to be inherent, in fairest degree—more nearly as do the females.

Measurements, in Millimeters, of Adult Specimens of *Thomomys bottae ingens*
(The largest five of each sex, out of the available series of twenty)

Number M. V. Z.	Sex	Date	Total length	Length of tail	Hind foot	Ear from crown	Weight (in grams)	Basilar length of Hensel	Greatest length of nasals	Zygomatic breadth	Mastoid breadth	Greatest width of rostrum, near middle	Least interorbital constriction	Alveolar length upper molar series
28294	♂	May 3, 1918	285	86	40	7	327	45.5	17.0	34.2	26.5	11.4	6.1	10.2
51421*	♂	Feb. 26, 1932	275	85	35	6	278	41.8	17.6	32.0	26.6	10.7	6.6	9.4
51424	♂	Feb. 27, 1932	261	83	37	5	219	40.5	16.6	29.1	24.3	9.6	6.3	9.0
28295	♂	May 4, 1918	252	82	37	6	200	38.6	13.7	27.6	22.9	9.3	7.0	9.4
51422	♂	Feb. 26, 1932	240	84	31	5	168	37.5	15.8	27.7	21.8	8.9	6.6	8.2
51430	♀	Feb. 27, 1932	235	65	31	....	186	38.9	15.5	26.7	23.0	8.8	6.9	8.6
51431	♀	Feb. 27, 1932	247	71	31	....	185	37.8	15.6	27.1	22.5	9.0	7.1	8.3
28292	♀	May 3, 1918	225	70	34	7	171	36.1	13.3	26.1	21.6	8.7	7.0	9.2
51429	♀	Feb. 27, 1932	235	72	31	....	180	36.1	13.9	25.6	22.2	9.0	6.9	8.4
51423	♀	Feb. 26, 1932	230	56	30	5	159	34.4	13.6	25.3	21.5	8.5	6.6	8.8

* Type.

Comparisons and Remarks.—Pocket gophers at hand from several points in the territory immediately surrounding the basin of Buena Vista Lake do not indicate present intergradation between *ingens* and the adjacent upland race for which I here use the name *pascalis*. This statement applies to specimens from the following localities, all in Kern County: 8 miles northeast of Bakersfield, 450 feet altitude; "Bakersfield" (in this case, no notebook record to show just where the specimens were taken); Rose Station, 1300 feet; San Emigdio Creek at 1500 feet. By the non-intergradation test, therefore, *ingens* should be rated as a full species. But the form is an extreme modification so clearly from *bottae* stock that phylogenetic relationship can, I now believe, best be shown by using the trinomial, as here done. Actual intergradation to the northward possibly does occur, but no specimens are available to show it.

Taking the aggregate of characters into account, the subspecies nearest like *ingens* is *pascalis*. The type locality of *pascalis* is Fresno. Using the large series of specimens available from within a radius of 12 miles of Fresno as basis of comparison, the differences are conspicuous. *Pascalis* is decidedly the smaller, sex for sex, and age for age. Its color is brighter, more clearly ochraceous, in both summer and winter pelages. The teeth are smaller, especially the incisors, and this holds for young wherein the bulk of the skull is the same as in *ingens*. In *pascalis* the auditory bullae are large as compared with their condition in *angularis*, *infrapallidus* and *bottae*, yet they are small in comparison with *ingens*. Indeed, *ingens*, whatever the sex or age, can be told from any like stage in any other race of *bottae* in so far as I have carried comparison, by the great degree of inflation of the bullae. The weaker rostrum in *pascalis* than in *ingens* reflects itself in much narrower and, as a rule, shorter nasals. While the locality representations above referred to from closest about the range of *ingens* are not typical of *pascalis*, they share their characters most closely with the topotypes of that race rather than with *ingens*.

The Buena Vista Lake pocket gophers found in 1918 near Conner were recorded (J. Dixon, MS) as plentiful along canal banks and in those "checks" which had not been irrigated for some time. In one field of ten acres the counting of groups of mounds indicated that there were then present about ten gophers per acre. This estimate included young-of-the-year which by May 3 were occupying each a burrow by itself. Of the eight specimens preserved, only one, a male, was really old; none of the four females was pregnant.

The present year, February 26 and 27, I found gopher sign here and there on the low ground both inside and outside the eastside levee. Some workings were noted in the earth of the outer wall of the levee itself and in both bases of it. It looked as though the gophers residing in the levee proper, at times of inundation of the adjacent low ground form the population nucleus from which individuals spread out when the waters recede, and thus can quickly repopulate the low ground. Workings were found as far out as looked for on the inside of the levee—to a distance of fully 300 yards from it. Even the beds of the depressions paralleling the levees, several feet below the level of the lake bed, were then dry.

At the time of my visit, following copious midwinter rains, a lush growth of first-crop annual vegetation covered the ground. The chief constituent of this new growth was filaree (*Erodium*). This was the preferred food of the gophers as shown by examination of the "shorn" circles about the orifices of those holes which were not marked by mounds. There was no newly cultivated ground in the territory in which these observations were made. Breeding had been under way for many weeks, since four out of the twelve gophers taken were young, half grown or less. The smallest one of these (no. 51427, collected by myself, weight 83 grams, basilar length of Hensel 29.7 millimeters) was a female containing 6 small embryos! An older, probably yearling, female (no. 51426, weight 183 grams) I found to contain 15 embroys each 7 to 8 millimeters in diameter, 8 in left horn of uterus, 7 in right; mammae, 4 inguinal, 4 pectoral, as in all the other females trapped. There was thus promise that the reproductive ratio this year would be high! Of the entire series of 20 specimens of *ingens* at hand, 8 are males, 12 females—which might seem to indicate a decided preponderance of the latter sex.

Transmitted June 21, 1932.

PLATE 7

Adult skulls of three contiguous subspecies of the "*Thomomys bottae* group" of pocket gophers; photographed separately, natural size, and reproduced × 1; not routed out.

a, d, T. b. pascalis Merriam; ♂, no. 14193, Mus. Vert Zool.; Lane Bridge, 10 miles north of Fresno, Fresno County, California; April 7, 1911; collected by J. Grinnell.

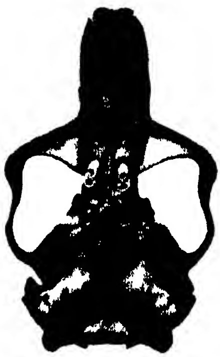
b, e, T. b. ingens Grinnell; ♂, no. 51421, Mus. Vert. Zool., type specimen; near east side levee (2 miles west of Millux), Buena Vista Lake, Kern County, California; February 26, 1932; collected by J. Grinnell.

c, f, T. b. angularis Merriam; ♂, no. 14145, Mus. Vert. Zool.; Los Baños, Merced County, California; March 22, 1911; collected by H. S. Swarth.

g, T. b. pascalis Merriam; ♀, no. 14199, Mus. Vert. Zool.; Lane Bridge, 10 miles north of Fresno, Fresno County, California; April 8, 1911; collected by J. Grinnell and W. L. Chandler.

h, T. b. ingens Grinnell; ♀, no. 51431, Mus. Vert. Zool.; near east side levee (2 miles west of Millux), Buena Vista Lake, Kern County, California; February 27, 1932; collected by W. C. Russell.

i, T. b. angularis Merriam; ♀, no. 14140, Mus. Vert. Zool.; Los Baños, Merced County, California; March 21, 1911; collected by H. S. Swarth.



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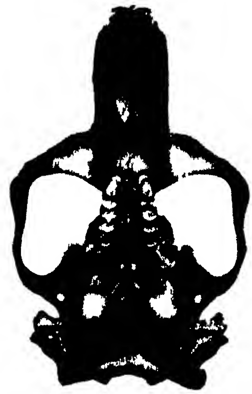

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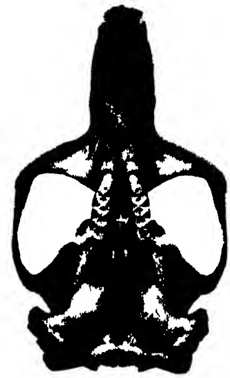

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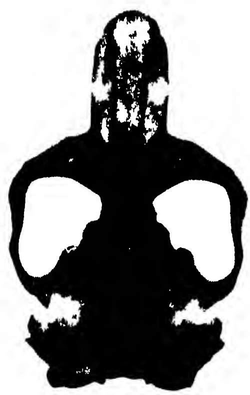

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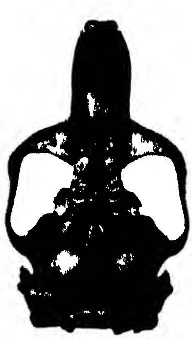

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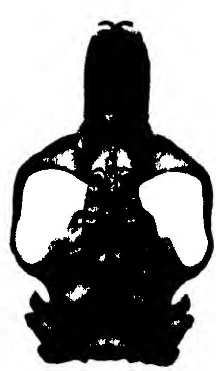

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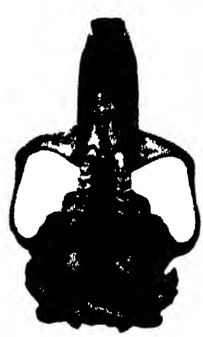

i

A NEW POCKET GOPHER FROM NEW MEXICO

BY

E. RAYMOND HALL

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A NEW POCKET GOPHER FROM NEW MEXICO

BY

E. RAYMOND HALL

(Contribution from the University of California Museum of Vertebrate Zoology)

An unnamed race of pocket gopher taken last year by Miss Annie M. Alexander and Miss Louise Kellogg has awaited description until the present time because of the need for comparing it with the related *Thomomys baileyi.* Now that the necessary opportunity for making comparisons has been afforded, by Dr. H. H. T. Jackson, who recently permitted examination of the specimens under his charge in the National Museum, the new race may be named and described as follows:

Thomomys baileyi tularosae new subspecies

Type.—Female, adult, skin and skull; no. 50444, Mus. Vert. Zool.; Cook Ranch, ½ mile west of Tularosa, Otero County, New Mexico; October 12, 1931; collected by Louise Kellogg, original no. 1195.

Diagnosis.—Size: Large (see measurements). Color (October-taken specimens): Brownish above with wash of ochraceous-buff; sides and pectoral region ochraceous-buff; under parts plumbeous with strong wash of ochraceous-buff; nose blackish; feet and distal third of tail white. Skull: Large, broad; rostrum short and broad; nasals truncate or semi-truncate posteriorly.

Specimens examined.—Twenty from the type locality. Nine are in the collection of the United States National Museum and eleven in the collection of the Museum of Vertebrate Zoology.

Comparisons.—Outstanding cranial differences from *Thomomys baileyi baileyi* Merriam as represented by the type and eight topotypes, are: Greater size; relatively shorter and broader rostrum; relatively shorter nasals, which, posteriorly, are truncate, or semi-truncate, rather than emarginate; greater relative breadth across mastoid region; actually and relatively smaller interorbital breadth; temporal ridges less bowed outward near middle and thus more nearly straight. Also, *tularosae* is larger throughout and averages slightly darker above than *baileyi.*

AVERAGE, MINIMUM, AND MAXIMUM MEASUREMENTS, IN MILLIMETERS, OF ADULT TOPOTYPES (INCLUDING TYPES) OF TWO SUBSPECIES OF *Thomomys baileyi*

Subspecies	Total length	Length of tail	Length of hind foot	Basilar length	Length of rostrum*	Length of nasals	Zygomatic breadth	Mastoid breadth	Least interorbital breadth	Alveolar length of upper molar series	Breadth of rostrum
Tularosae, 8 ♂♂ ..	252 (235–274)	79 (68–100)	32.5 (30–34)	37.7 (35.5–40.4)	18.8 (17.6–20.8)	14.7 (13.6–16.5)	26.9 (25.1–29.5)	21.6 (20.3–23.6)	7.0 (6.6–7.3)	8.2 (7.8–9.0)	8.6 (8.0–9.5)
Baileyi, 2 ♂♂† ..	215, 215	68, 64	35, 31	34.6, 32.8	17.4, 17.4	13.8, 13.6	25.1, 23.9	20.0, 18.7	6.2, 6.9	8.0, 7.7	7.2, 7.2
Tularosae, 12 ♀♀ ..	231 (210–251)	73 (54–93)	30.0 (26–32)	34.8 (32.3–36.0)	17.5 (16.1–19.0)	13.0 (12.0–14.0)	25.1 (22.9–26.5)	20.2 (18.5–21.4)	7.0 (6.6–7.3)	7.9 (7.2–8.0)	8.0 (7.5–8.6)
Baileyi, 6 ♀♀ ..	210 (200–225)	68 (62–75)	30 (28–32)	32.5 (31.1–34.3)	16.4 (15.3–17.8)	12.7 (12.0–13.8)	23.9 (22.0–25.8)	18.9 (18.1–19.5)	7.1 (6.8–7.5)	7.5 (7.0–7.9)	7.5 (7.0–8.2)

* Length of rostrum amounts to distance from anterior ends of premaxillae to junction of lacrymal process and zygomatic arm of maxilla at lateral end of lacrymal

† Nos. 247186 and 24971, U. S. Nat. Mus. respectively

As compared with *Thomomys lachuguilla* Bailey, represented by the type and nine topotypes, *tularosae* is larger throughout; has a broader skull with weaker zygomatic arches; less recurved upper incisors; less inflated auditory bullae. Also, in *tularosae* the premaxillae do not extend so far posteriorly of the nasals, and by actual weight the skull is nearly as heavy again as that of *lachuguilla.*

Remarks.—In 1915, Bailey (N. Am. Fauna, no. 39, p. 88) referred specimens of the here newly named race *tularosae* to *Thomomys baileyi* but commented on some of the differential structural features.

Probably *tularosae* eventually will be found to intergrade with the *fulvus* series and thus take the specific name *bottae* (see Hall, Univ. Calif. Publ. Zool., **38**:325, February 27, 1932). In the absence of actual intergrades, however, it seems best for the present, to link *tularosae,* by subspecific designation, to its relative which is structurally most similar, namely, *Thomomys baileyi.*

Transmitted June 24, 1932.

REMARKS ON THE AFFINITIES OF THE MAMMALIAN FAUNA OF VANCOUVER ISLAND, BRITISH COLUMBIA, WITH DESCRIPTIONS OF NEW SUBSPECIES

BY

E. RAYMOND HALL

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REMARKS ON THE AFFINITIES OF THE MAMMALIAN FAUNA OF VANCOUVER ISLAND, BRITISH COLUMBIA, WITH DESCRIPTIONS OF NEW SUBSPECIES

BY

E. RAYMOND HALL

(Contribution from the University of California Museum of Vertebrate Zoology)

In 1912, when Swarth reported (Univ. Calif. Publ. Zool., **10**:1–124) upon the vertebrate materials obtained from Vancouver Island as a result of the field work which Miss Annie M. Alexander sponsored and also participated in, he listed nineteen species of land mammals. Excluding the non-native Norway rat and the two aerial mammals, bats, sixteen native species remained, to which there should now be added a second species of shrew not distinguished by Swarth.

In Swarth's faunal analysis of the region, he noted as especially worthy of remark concerning the mammals, the absence of many genera found on the adjacent mainland and the fact that only three forms (*op. cit.*, p. 113) were "not known to occur elsewhere." Since that time, however, additional study has shown that many of the mammals of Vancouver Island are recognizably different from mammals found anywhere else. Indeed, of the seventeen species just mentioned, fourteen (including those named for the first time in the present paper) are species or subspecies restricted to Vancouver Island.

The three mammals which have not been found to differ from mainland representatives are the deer, the otter, and the wolverine. The latter is known to me from a skin-only. The otter, on the basis of one adult specimen, cannot be distinguished from Alaskan specimens. The deer is different from those on the mainland. An account of its characters will be presented by Ian McTaggart-Cowan, along with other results of his study of western North American deer now in progress. Thus fifteen of the seventeen mammals mentioned are known to be distinct from any races described from the mainland or other islands.

A list of the twenty kinds of mammals from Vancouver Island of which specimens happen to be available to me, together with citations to authorities for the names used, is as follows:

Sorex vagrans vancouverensis Merriam
Jackson, N. Am. Fauna, 1928, 51:106
Sorex obscurus isolatus Jackson
Jackson, N. Am. Fauna, 1928, 51:134
Myotis lucifugus alascensis Miller
Miller and Allen, Bull. U. S. Nat. Mus., 1928, 144:47
Eptesicus fuscus fuscus (Peale and Beauvois)
Miller, Bull. U. S. Nat. Mus., 1924, 128:76
Ursus americanus vancouveri Hall
Hall, Univ. Calif. Publ. Zool., 1928, 30:231
Procyon lotor vancouverensis Nelson and Goldman
Nelson and Goldman, Jour. Mammalogy, 1930, 11:458
Martes caurina vancouverensis Grinnell and Dixon
Grinnell and Dixon, Univ. Calif. Publ. Zool., 1926, 21:414
Mustela cicognanii anguinae Hall
Present paper, p. 417.
Mustela vison evagor Hall
Present paper, p. 418.
Gulo luscus (Linnaeus)
Miller, Bull. U. S. Nat. Mus., 1924, 128:128
Lutra canadensis periclyzomae Elliot
Swarth, Univ. Calif. Publ. Zool., 1912, 10:101
Canis occidentalis crassodon Hall
Present paper, p. 420.
Felis concolor vancouverensis Nelson and Goldman
Nelson and Goldman, Proc. Biol. Soc. Wash., 1932, 45:105
Marmota vancouverensis Swarth
Howell, N. Am. Fauna, 1915, 37:70
Sciurus hudsonicus vancouverensis Allen
Allen, Bull. Am. Mus. Nat. Hist., 1898, 10:263
Castor canadensis leucodontus Gray
Miller, Bull. U. S. Nat. Mus., 1924, 128:299
Peromyscus maniculatus angustus Hall
Present paper, p. 422.
Microtus tetramerus (Rhoads)
Bailey, N. Am. Fauna, 1900, 17:47
Rattus norvegicus norvegicus (Erxleben)
Argyropulo, Zeitschr. f. Säugetierkunde, 1928, 2:140
Odocoileus columbianus columbianus (Richardson)
Miller, Bull. U. S. Nat. Mus., 1924, 128:484

When one seeks to ascertain the geographic affinity of the mammals of Vancouver Island by noting the relative degrees of their structural agreement with those on the adjacent mainland, and with those in southeastern Alaska, it develops that nine of the kinds have their nearest relatives in southern British Columbia and six are more like the ones which

occur in southeastern Alaska. One, the wolverine, does not permit of analysis in this direction because of inadequate material. It may be further noted that the three insular forms representing *Procyon, Felis,* and *Sorex vagrans* belong to groups which even on the mainland do not range much, if any, northward beyond Vancouver Island. By eliminating these and restricting ourselves to the twelve groups which have representatives both in southeastern Alaska and in southern British Columbia, we find that the insular fauna in question shows almost equal affinity with the two mainland areas mentioned.

Mustela cicognanii anguinae new subspecies

Type.—Male adult, complete skeleton; no. 12482, Mus. Vert. Zool.; French Creek, Vancouver Island, British Columbia; found as a desiccated carcass on May 1, 1910 (see Swarth, *op. cit.*, p. 102).

Range.—Vancouver Island, British Columbia.

Diagnosis.—Size: Small (see measurements). Color: In summer pelage near (n) Vandyke brown (of Ridgway, Color Standards and Color Nomenclature, 1912) above and white below; color of underparts much restricted, not extended distally on hind limbs beyond knee, often marked with irregularly shaped, isolated patches of brown, and widest just behind fore legs; chin and lower lips usually brown; black pencil of tail weakly developed; winter pelage usually, but not always, white. Skull: Small with relatively great interorbital breadth and flattened braincase.

Comparisons.—From *Mustela cicognanii streatori*, *M. c. anguinae* differs in greater average size, generally brown rather than white chin and lower lips, and larger skull with shallower braincase which is less convex dorsally in both longitudinal and transverse axes. From *M. c. cicognanii*, *M. c. richardsonii*, and *M. c. alascensis*, *M. c. anguinae* is readily distinguished by smaller size, more restricted light-colored underparts, reduction in extent of black pencil on tail, and by constantly smaller skull in which the braincase is more flattened and the anterior margins of the tympanic bullae are less elevated (in dorsal view) above the squamosal bone. Selected characters in which *M. c. anguinae* differs from *Mustela haidarum* are as follows: Color of underparts narrower and absent from, rather than present on, the hind feet; black pencil on tail near one-third, rather than one-half, length of tail including hairs at tip; skull constantly smaller, as for example in length of tooth-rows which, in adult males, always are less than, rather than more than, 12.7 mm.

Measurements.—Two adult males, no. 393 coll. Kenneth Dacey and the type specimen, measure, respectively, as follows: Total length, 275, 235; length of tail, 85, 70; length of hind foot, 35, 34; basilar length, 34.3, 34.4; length of tooth-rows, 11.5, 11.8; mastoid breadth, 17.1, 17.4; depth of skull at anterior margin of basioccipital, 11.2, 11.0. The external measurements of the type specimen were obtained from the relaxed carcass many years after it had become dry.

Remarks.—*Mustela cicognanii anguinae* is only slightly different from its nearest relative, *M. c. streatori,* abundant material of which is available from the coastal region of Oregon and Washington and from southern British Columbia. In this respect the weasel is unlike the mink and wolf of Vancouver Island, which are structurally more similar to forms found to the northward rather than to forms found in southern British Columbia.

I am glad here to express appreciation to Mr. Arthur Peake and Mr. E. Despard who have been so kind as to procure needed specimens of this weasel, as well as to Mr. Kenneth Racey and Mr. Francis Kermode for the privilege of examining other specimens.

Specimens examined.—Total number, 11; all from Vancouver Island, British Columbia, as follows: Comox, 4; Craigs Crossing, 1; Duncan, 2; Errington, 1; French Creek, 1; Hilliers, 1; Stamp River, Alberni, 1.

Mustela vison evagor new subspecies

Type.—Male adult, skin, skull, and skeleton; no. 12479, Mus. Vert. Zool.; Little Qualicum River [eight to nine miles west of Parksville], Vancouver Island, British Columbia; May 11, 1910; collected by E. Despard; original no. 4.

Range.—Vancouver Island, British Columbia.

Diagnosis.—Size: Large (see measurements). Color (May-taken specimens): General tone slightly more reddish than Vandyke brown (of Ridgway, 1912); darkest on top of head, along median line of back, tip of tail and scrotum; underfur avellaneous; disconnected areas of white on chin, throat, breast and inguinal region. Skull: Large, relatively broad; teeth, and especially last upper molars, large (see measurements); tympanic bullae of moderate size, but length of bulla, as measured from foramen ovale to foramen lacerum posterior, more than width of basioccipital as measured from the medial margin of one foramen lacerum posterior to its opposite.

Remarks.—*Mustela vison evagor* is a relatively large animal about the size of *nesolestes.* Indeed *nesolestes* appears to be the nearest relative of *evagor* but it is readily distinguishable from the latter form, and from *energumenos* as well, by the fact that the length of the tympanic bulla is less than, rather than more than, the width of the basioccipital when these distances are measured as indicated above under heading of "*Diagnosis.*" As between *evagor* and *energumenos* the two differential characters most readily apparent are the larger teeth and lighter color of *evagor.*

Specimens examined.—Total number, 7; all from Vancouver Island, British Columbia, as follows: Little Qualicum River, eight to nine miles west of Parksville, 3; French Creek, 2; Hall's Ranch, Alberni Valley, 1; Friendly Cove, Nootka Sound, 1 skull-only.

MEASUREMENTS, IN MILLIMETERS, OF TWO SUBSPECIES OF *Mustela vison*. ALL SPECIMENS ARE ADULT MALES

Mus. Vert. Zool. Catalogue No.	Locality	Total length	Length of tail	Length of hind foot	Condylobasal length	Length of upper tooth-rows	Length of upper molar-premolar row	Zygomatic breadth	Mastoid breadth	Least postorbital constriction	Length of tympanic bulla*	Width of basioccipital†	Inside length of P^4	Breadth of M^1	Length of M^1
	Mustela vison evagor														
12480	Little Qualicum R., V. I.	640	200	82	73.8	26.6	19.5	44.6	38.7	14.0	14.6	13.8	9.6	7.9	9.3
12479	Little Qualicum R., V. I.	596	190	80	70.3	26.1	19.2	42.5	37.7	12.2	13.5	13.2	9.0	7.7	9.1
12481	Alberni Valley, V. I.	563	161	70	68.0	25.1	18.7	41.8	36.2	13.8	13.8	13.6	9.0	7.3	8.6
12478	Little Qualicum R., V. I.	557	183	70	66.4	24.4	17.9	40.3	33.9	12.7	12.7	11.6	8.8	6.9	8.7
12477	French Creek, V. I.	559	165	64	64.6	23.6	17.7	40.6	32.0	12.3	13.4	12.5	8.5	7.1	8.4
–	Average of 5 adult males	583	180	73	68.6	25.2	18.6	42.0	35.7	13.0	13.6	12.9	9.0	7.4	8.8
	Mustela vison nesolestes														
200	Admiralty Id., Alaska	585	175	83	70.5	26.0	19.1	41.0	35.5	11.9	12.9	13.3	9.3	7.3	9.0
8818	Admiralty Id., Alaska	......	......	....	70.5	25.9	18.9	42.0	36.9	12.1	13.7	13.8	9.2	7.0	9.3
201	Admiralty Id., Alaska	615	182	80	70.3	25.8	19.2	42.6	35.7	12.5	13.4	12.6	9.2	7.2	8.7
206	Admiralty Id., Alaska	612	175	73	69.4	25.6	19.0	41.5	35.8	12.2	13.3	13.6	9.0	7.2	9.0
8798	Coronation Id., Alaska	580	170	75	68.1	24.8	18.0	40.1	34.8	13.6	12.6	13.6	8.8	6.8	8.8
	Average of 5 adult males	598	176	77	69.8	25.6	18.8	41.4	35.7	12.5	13.2	13.3	9.1	7.1	9.0

* Measured from foramen ovale to foramen lacerum posterior.

† Measured from medial margin of one foramen lacerum posterior to its opposite.

Canis occidentalis crassodon new subspecies

Type.—Male adult, skull-only; no. 12456, Mus. Vert. Zool.; Tahsis Canal, Nootka Sound, Vancouver Island, British Columbia; collected during winter of 1909–10 by Carl Leiner from whom procured on July 26, 1910, by H. S. Swarth; original no. 8419, H. S. S.

Range.—Vancouver Island, British Columbia.

Diagnosis.—Size: Medium (see measurements). Color: Gray to black. Skull: Relatively broad; preorbital portion short; mastoid breadth amounting to more than four-fifths of postpalatal length; inferior margin of lower jaw relatively straight; angle between posterior border of coronoid process and long axis of horizontal ramus more than 90°; teeth massive; P^4 with antero-external angle full and square.

Comparisons.—Skulls of the Vancouver Island race differ from those of *Canis o. occidentalis* from northern British Columbia and topotypes of *Canis pambasileus* as follows: Smaller; braincase and teeth of similar size but preorbital region shortened and tip of rostrum less elevated; lower jaw much shallower through coronoid process but with postmolar portion less elevated above the horizontal ramus.

Remarks.—The Vancouver Island wolf clearly is a close relative of *Canis occidentalis,* as this name is applied by Miller (Smithson. Misc. Colls., **59**: no. 15, p. 4, June 8, 1912), and *Canis pambasileus* Elliot. Whether or not *pambasileus* is even subspecifically distinct from *occidentalis* is a question that we need not attempt to settle for purposes of the present discussion. Suffice it to say that *crassodon* is a near relative of the wolves of the northern interior forests and of southern and central Alaska and is not so closely related to the plains type of wolf as that wolf is known to me through specimens from northwestern Oregon to which the name *Canis gigas* Townsend would seem to apply.

The Oregon specimens at once are seen to differ from those taken on Vancouver Island in the markedly less inflated tympanic bullae, much smaller teeth, more ventrally convex inferior margin of the lower jaw, and in other characters of the skull.

Although *crassodon* has a smaller skull than *occidentalis* or *pambasileus,* it is relatively wider except across the zygomata which are relatively no more robust or widely bowed than in the two mainland forms. This relatively greater width is reflected in the circumstance that *crassodon* has the mastoid breadth amounting to more than, rather than less than, four-fifths of the post-palatal length. Also, in the mainland wolf (*occidentalis* and *pambasileus*) the skull, when placed palate down on a flat surface, rests on the upper carnassials and tympanic bullae, with the tips of the canines some distance above this plane, whereas the skull of *crassodon,* in the same position, rests on the tympanic bullae and tips of

the canines, while the carnassials do not even touch the supporting plane. This difference in alignment of the three most ventral projecting points of the cranium seems to result from the assumption of a more ventral position of the molar-bearing portion of the maxillary bone in the mainland forms.

Probably this structural feature is correlated with the shape of the lower jaw, which, in *crassodon,* has the post-molar part less elevated above the horizontal ramus. Also, if, on a horizontal surface, the jaws be supported on the tips of the canines and coronoid processes, the posterior border of the coronoid process is seen to be very near the vertical in the mainland wolf, but in *crassodon* it extends postero-ventrally to form an angle of more than 20° from the vertical. Stated in another way, the tip of the coronoid process, in this inverted position, projects posteriorly rather than straight ventrally. Another differential feature of the Vancouver Island race is the full, nearly square, antero-lateral angle of P^4 which is weakly developed and evenly rounded in the mainland wolves.

The coloration of this insular race of wolf is stated above (under "*Diagnosis*") to be black as well as gray, on the basis of information furnished me by Mr. Ian McTaggart-Cowan, who reports the occurrence of this dark color phase on the Island. The skin-only from Nootka Sound, examined in connection with the present writing, is gray with black along the mid-dorsal area. A full description of this skin has been given by Swarth (*op. cit.*, p. 100).

Specimens examined.—Total number, 5; all from Vancouver Island, British Columbia, as follows: Englishmans River, 1 skull-only; Tahsis Canal, 3 skulls-only; near Friendly Cove, 1 skin-only.

MEASUREMENTS, IN MILLIMETERS, OF FOUR SKULLS OF *Canis occidentalis*

Mus. Vert. Zool. Catalogue No.	Sex and age	Subspecies	Locality	Condylobasal length	Length of tooth-rows	Postpalatal length	Greatest width across upper tooth-rows	Mastoid breadth	Depth of mandible through coronoid process	Mastoid breadth divided by postpalatal length
12456	♂ ad.	*C. o. crassodon*	Vancouver Island	240 1	126.6	98.1	89 2	88 0	70 5	90%
12457	♂ ? ad	*C. o. crassodon*	Vancouver Island	239.0	127.2	99.2	83 0	85 8	69 0	87%
31043	♂ ? ad.	*C. o. occidentalis*	60 mi. S. Telegraph Creek	262.6	137.5	115 3	87 0	88 3	85 5	76%
44166	♂ ad.	*C. o. pambasileus*	Mount McKinley	251.0	134.9	106.6	82 9	83 7	81 7	78%

MEASUREMENTS, IN MILLIMETERS, OF TWO SUBSPECIES OF *Peromyscus maniculatus*

Mus. Vert. Zool. Catalogue No.	Sex and age	Locality	Total length	Length of tail	Length of hind foot	Greatest length of skull	Basilar length	Zygomatic breadth	Interorbital constriction	Interparietal	Nasals, length	Shelf of bony palate	Palatine slits	Diastema	Postpalatal length	Maxillary tooth-row	Mastoid breadth
		Peromyscus maniculatus angustus															
12269	♀ ad.	Beaver Creek, V Id, B. C	179	83	20	25.3	21.3	13.4	3.9	8.8×3.0	10.9	3.8	5.6	7.1	9.1	3.6	11.0
12275	♀ ad.	Beaver Creek, V. Id, B. C	188	93	20		21.6	13.3	3.9	8.9×2.7		4.0	5.5	7.2	9.3	3.1	11.0
12276	♀ ad.	Beaver Creek, V. Id., B. C	178	84	20	24.9	20.8	12.9	3.8	8.8×3.5	10.0	3.5	5.5	6.9	9.0	3.6	10.9
12307	♀ ad.	Nootka Sound, V. Id, B. C	190	98	21	26.0	21.7	13.3	3.8	8.8×2.8	10.7	4.0	5.6	7.4	9.4	3.5	10.9
12308	♂ ad.	Nootka Sound, V Id, B C	185	95	21	25.9	21.5	13.7	3.9	9.6×3.1	10.2	4.0	5.8	7.2	9.3	3.2	11.1
		Average of 5	185	90.6	20.4	25.5	21.4	13.3	3.9	9.0×3.8	10.5	3.9	5.6	7.2	9.2	3.4	11.0
		Peromyscus maniculatus austerus															
4394	♂ ad.	Seattle, King Co, Wash.	182	96	22	25.3	20.8	12.7	3.8	8.9×3.0	10.1	3.7	5.4	6.8	9.0	3.6	10.8
4395	♀ ad.	Seattle, King Co., Wash	190	96	21	25.9	21.9	13.6	4.0	9.4×2.5	10.2	3.6	5.8	7.0	9.8	3.5	11.0
3733	♀ ad.	Seattle, King Co, Wash.	173	92	21	24.4	20.2	12.8	4.0	7.7×2.5	9.9	3.7	5.2	6.5	8.6	3.6	10.6
51211	♂ ad.	Seattle, King Co, Wash	172	83	22	24.8	19.9	12.6	4.0	8.9×3.5	10.5	3.6	5.3	6.5	8.8	3.5	10.6
51212	♂ ad.	Seattle, King Co., Wash.	183	89	22	26.0	21.6	13.0	3.9	9.0×3.0	10.0	4.1	5.3	6.8	9.6	3.4	11.2
		Average of 5	180	91.2	21.6	25.3	20.9	12.9	3.9	8.8×2.9	10.1	3.7	5.4	6.7	9.2	3.5	10.8

Peromyscus maniculatus angustus new subspecies

Type.—Female, adult, skin and skull; no. 12269, Mus. Vert. Zool.; Beaver Creek, fifteen miles northwest of Alberni, Vancouver Island, British Columbia; June 25, 1910; collected by Louise Kellogg; original no. 958.

Range.—Vancouver Island, British Columbia.

Diagnosis.—Size: Large (see measurements). Color: Brownish as opposed to the more blackish colored races on the adjacent mainland. Skull: Large with short braincase and long preglenoid portion. Tympanic bullae large.

Comparison.—As compared with its nearest relative, *Peromyscus maniculatus austerus* of the adjacent mainland, *P. m. angustus* is of similar size, more brownish (less blackish) above, and has those parts of the skull anterior to the glenoid region relatively, as well as actually, longer. Also, in *angustus,* the tympanic bullae are larger and the least interorbital constriction averages actually less.

Remarks.—Osgood (N. Am. Fauna, 1909, no. **28** :64) commented upon the wider braincase of the Vancouver Island specimens available to him in comparison with *austerus.* Actual measurments of the skulls examined by me indicate that this broadness is more apparent than real. The relatively shorter braincase of the Vancouver Island specimens causes this part of the skull to look relatively wider than it really is when set alongside of *austerus* from the mainland.

Specimens examined.—Total number, 195; all from Vancouver Island, British Columbia, as follows: Nanaimo, 1; Parksville, 14; Little Qualicum River, 7; Errington, 1; Golden Eagle Mine, 21; Beaver Creek, 126; Nootka Sound, 12. The above mentioned places all may be located by reference to Swarth's (*op. cit.*, pl. 1) account of the birds and mammals of Vancouver Island.

Transmitted September 13, 1932.

POSTJUVENAL MOLT AND THE APPEARANCE OF SEXUAL CHARACTERS OF PLUMAGE IN PHAINOPEPLA NITENS

BY

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INTRODUCTION

Plumages of passerine birds borne during the first year of the bird's life are usually composed of two sets of feathers, the juvenal feathers grown during the postnatal molt and acquired while in the nest, and postjuvenal feathers gained during the postjuvenal or, as it may be termed, first fall molt. The resultant mixed plumage may be further complicated later at the prenuptial molt through the partial replacement of certain of the postjuvenal body feathers. Dwight (1905), Heinroth (1931), and others have shown that various passerine families, genera, and species may exhibit more or less constant peculiarities of this mixed first-year plumage. The molt programs of most North American and European birds are known in a general way at the present time, but further analyses, particularly of the postjuvenal molt, in a number of instances can yield new information regarding the causes underlying and governing natural incompleteness of molts. Few passerine groups have complete postjuvenal molts according to Dwight (*loc. cit.*), the best known of those with complete molts being the Alaudidae, Tyrannidae, Hirundinidae and certain species of sparrows and icterids.

Studies of the molts of the Loggerhead Shrike, *Lanius ludovicianus* (Miller, 1928, and 1931, pp. 124–140), have demonstrated that a pronounced geographic variation in the completeness of the first fall molt exists within this species. The variation appears to be associated not only with migration and with length of summer season but also with the structural features that differentiate subspecies. Within the species *L. ludovicianus* every stage is represented between nearly complete postjuvenal molts (lacking replacements of two secondaries and a few primaries and primary coverts only) and a type of incomplete molt in which no primaries or secondaries are replaced.

In the Phainopepla, *Phainopepla nitens* (Swainson), member of the small, mainly neotropical family Ptilogonatidae, an even greater range

of variability in first-year plumages has been found than in the shrike. Like the shrike there is variation according to geographic area, but in this instance within but one race, *Phainopepla nitens lepida* Van Tyne. What the condition may be in *P. nitens nitens* of Mexico I have no means of determining at the present time. The admixture of plumage can be adequately studied only in the male Phainopepla. In this sex brown juvenal rectrices, remiges, and coverts stand in sharp contrast with corresponding glossy black feathers gained in the postjuvenal molt. Likewise the gray juvenal body plumage may be distinguished from the gray postjuvenal body feathers and contrasts sharply with black postjuvenal body feathers, either of which latter types may appear at the postjuvenal molt. Not infrequently the mixture of plumages and feather types produces grotesquely pied male individuals. These peculiar first-year males of course have not gone unnoticed. Coues (1903, p. 361) says of the young males: "during progress to maturity every gradation between the characters of the two sexes is observed." The analysis of the plumage variation appears to have been carried no farther until the present time.

Additional aspects of plumage study relating to the inception of the influence of the gonads upon the plumage are worthy of consideration in this strongly sexually dimorphic species. The characteristic black male pigmentation appears earlier in certain individuals than in others and is deposited in certain feather tracts often at an earlier molt than it is deposited in other tracts.

MATERIALS

Phainopeplas of the race *lepida* from California, Lower California, and Arizona, constituting a total of 245 have been examined in the following collections: California Academy of Sciences, Joseph Mailliard, G. Frean Morcom, Harry S. Swarth, Ralph Ellis, and Museum of Vertebrate Zoology. The author is indebted to the owners and custodians of these collections for use of the skins.

Of the total number of Phainopeplas studied, 175 were males of various ages. Postjuvenal and subsequent annual molts are each represented by at least twenty-five individuals in one stage or another of feather replacement. Many examples showing the prenuptial molts are available. A group of forty-three first-year males collected in each case subsequent to their postjuvenal molts, and thus showing a static condition of admixture of plumages, has been segregated to illustrate first-year plumage variation.

THE JUVENAL PLUMAGE

Without entering into a full description of this plumage, a few points will be noted that aid in the recognition of juvenal feathers when these are later admixed with postjuvenal feathers. The sexes are identical in the juvenal plumage and are extremely similar to the adult female. The body plumage is slightly browner throughout than is that of the adult female, but this appears to be due in part to the looser structure of the vanes of the feathers of the juvenile, which permits exposure of some of the basal parts of the feathers (see plate 9, figs. 11, 12). Color differences cannot be relied upon to distinguish juvenal body feathers from postjuvenal gray feathers because of complications brought about by wearing and fading. The best criterion for recognition is the wide spacing of the barbs on the shaft, especially in the feathers of the breast.

Contrasted with the adult female, the light-colored edgings on rectrices, on middle, greater, and marginal coverts of the forearm, and on the inner secondaries of juveniles are less definitely set off from the gray parts of these same feathers and are duskier or buffier. The major feathers of the wing and tail are often a lighter shade of dark brown than in adult females.

THE POSTJUVENAL MOLT

The sequence of feather replacement in this molt has been observed principally in male birds. Owing to the variation in completeness of the molt the sequence is not precisely the same in all individuals. The description of sequence given herewith is that of a complete postjuvenal molt. As is always true in molt sequence, minor exceptions and irregularities occur.

As in the shrikes the primaries do not initiate the postjuvenal molt as they do the annual molts. Either the body feathers or the marginals of the forearm molt first in the Phainopepla. In shrikes the marginals always molt first and their replacement usually proceeds for several weeks before additional areas of the body or wing become involved. In the Phainopepla the body takes up the molt almost immediately in case the marginal coverts initiate it. The body molt, as is usual in passerines, begins in the center of the breast in the ventral tracts and between the wings in the dorsal tracts, soon spreading anteriorly and posteriorly. All feathers are not involved in this initial spreading but some are left unmolted for a time, to be replaced later in the same molt. Molt also starts almost simultaneously on the forehead and spreads posteriorly

and laterally. Of particular significance is the fact that within the ventral tract in the body region the feathers in the central rows of each tract, as it divides around the carina, drop first. It follows that the feathers that cover the median ventral apterium and those covering the extreme sides are molted later than those which cover a stripe down either side of the breast and belly.

The exact sequence in the middle and greater secondary coverts I have not been able to determine owing to a lack of critical specimens. Apparently the two sets of coverts molt almost simultaneously and before the secondaries are replaced. The marginal coverts of the hand follow after those of the forearm and usually molt coincidently with the replacement of the greater and middle secondary coverts.

If the primaries are to be replaced, they start to drop before, or at the time of, replacement of the secondary coverts, as in *Lanius*. Replacement starts with the innermost, number 1, and proceeds outward. The molt does not start with the middle of the series, progressing outward and leaving a group of juvenal inner primaries, as it does in *Passerina cyanea,* some individuals of *Melospiza melodia* (see Dwight, 1900, pp. 202, 212), and in *Lanius ludovicianus.* In the Phainopepla any failure to molt all the primaries leaves the outer primaries juvenal. I was of the opinion at one time that the late initiation of the primary replacement in *Lanius* might be the cause of the replacement starting at a point partway through the series and hence the cause of the incomplete molt of these feathers. Obviously these causal relations cannot hold for the Phainopepla's late primary molt that starts with the inner members of the series and is frequently complete. The alula molts with the outer or digital primaries and the greater primary coverts usually molt with the corresponding primary, although it is to be noted that this series of coverts not uncommonly is retained in juvenal state in part or in its entirety even when all the primaries are changed.

Molt of the rectrices, if accomplished, accompanies roughly that of the inner primaries and starts at a time when the body molt has become general and has spread back toward the rump.

The secondaries start molting later than the primaries and rectrices, beginning with number 8, then proceeding to numbers 9 and 7. If more are to be changed, numbers 1 (outermost), 2, 3, 4, 5, and 6 usually are dropped in the order indicated. Occasionally some of the outer members are not replaced, but in such cases number 6 is still always the last one molted and follows only after the replacement of number 5. In shrikes, on the other hand, numbers 6, 5, and 4 follow in the order

indicated, after number 7. Shrikes never in this molt replace all secondaries, as do many Phainopeplas.

Postjuvenal Wing and Tail Feathers

The wing and tail feathers of the female grown in the postjuvenal molt are not distinguishable from those of adult female birds. In the male the postjuvenal remiges are glossy black as in adult males, the primaries possessing a white area basally except on numbers 1 and 10. The innermost secondaries occasionally bear white margins which never appear in the adult male (see plate 9, fig. 5). The black greater secondary coverts and often the middle and marginal coverts have white margins that are absent in the adult (plate 9, figs. 6, 7); otherwise these coverts are black, as in older birds. The white margins of the greater coverts vary greatly in width but seem always to be present to mark the first-year bird in case no betraying juvenal feathers are retained. The only difficulty in using these margins as an index of immaturity is that they wear more readily than do the black parts of the feathers and may be lost by late spring. In many instances, however, I have noted them present in specimens, one year of age, taken in June, July, and August. Thus they are less ephemeral than the very common white or gray edgings on the body feathers of immature birds of numerous passerine species. The under tail coverts are similarly black, tipped with white in contrast to pure black adult feathers. A few undoubted adults have been observed in which extremely minute traces of white were visible on these tail coverts immediately following the annual molt. No such traces have been detected in adult wing coverts.

The postjuvenal rectrices are indistinguishable from those of the adults. Only one instance has come to hand of a first-year bird wherein the rectrices were not pure black. This bird, no. 1114, coll. Ralph Ellis, molted very incompletely in the first fall, and the few replaced secondaries, rectrices, and coverts that normally should be black are dull brown, somewhat intermediate between those of adult males and females.

It would appear that the immature male Phainopepla has differentiated sexually at the time of the first fall molt sufficiently to stimulate deposition of black pigment in rectrices, remiges, and coverts. If any of these are not molted, there is, of course, no chance for this differentiation to find expression. That this differentiation is not perfectly complete is evinced by the production to a varying degree of white margins, a character of the female or nestling male.

VARIATION IN THE REPLACEMENT OF JUVENAL WING AND TAIL FEATHERS

Leaving for the time the consideration of the appearance of male characters, I will detail the variation in the number of feathers replaced in wing and tail, which is independent of sex. Females show the same molt as do males in so far as can be learned. Data as to variation, however, are based largely upon the male, as before pointed out, because of advantageous juvenal and postjuvenal plumage contrasts in this sex. The accompanying graph (fig. A) shows variation in replacement of the feathers in forty-three males that have finished the postjuvenal molt. The individuals, each represented by a horizontal section, are arranged so far as possible according to the number of retained juvenal feathers, the birds retaining the most juvenal primaries being placed at the top. In cases where juvenal primaries were not retained, the arrangement on the graph was made on the basis of secondaries and primary coverts. By this arrangement may be visualized the transition stages between the incomplete and complete types of molt. The squares representing retained primaries show the retention of the distal members in instances of partial replacement of this series; one exception is noted where a peculiar retention of the first primary alone is found. It should be noted that, in the primaries, replacement tends to take place completely or not at all, the partial replacements in this series being much fewer than in other groups of feathers. Retention of a juvenal alula follows closely the lead set by the primaries.

The secondaries show replacement in cases in which primaries are retained entirely in the juvenal state, but it is seen that only the inner three secondaries become involved. With partial or complete primary replacement a more complete, often erratic, replacement of the inner six secondaries ensues.

The primary coverts, especially the outer members, are the most persistent juvenal feathers of all. Most retained primary coverts, where the primaries are all replaced, are, however, accompanied by scattered juvenal secondaries.

The rectrices, other than the middle pair, number 1, adhere closely to the example set by the primaries, with one individual forming a decided exception. The retention of the central pair is not closely correlated with other replacements except that it is never retained when any of the lateral rectrices are replaced.

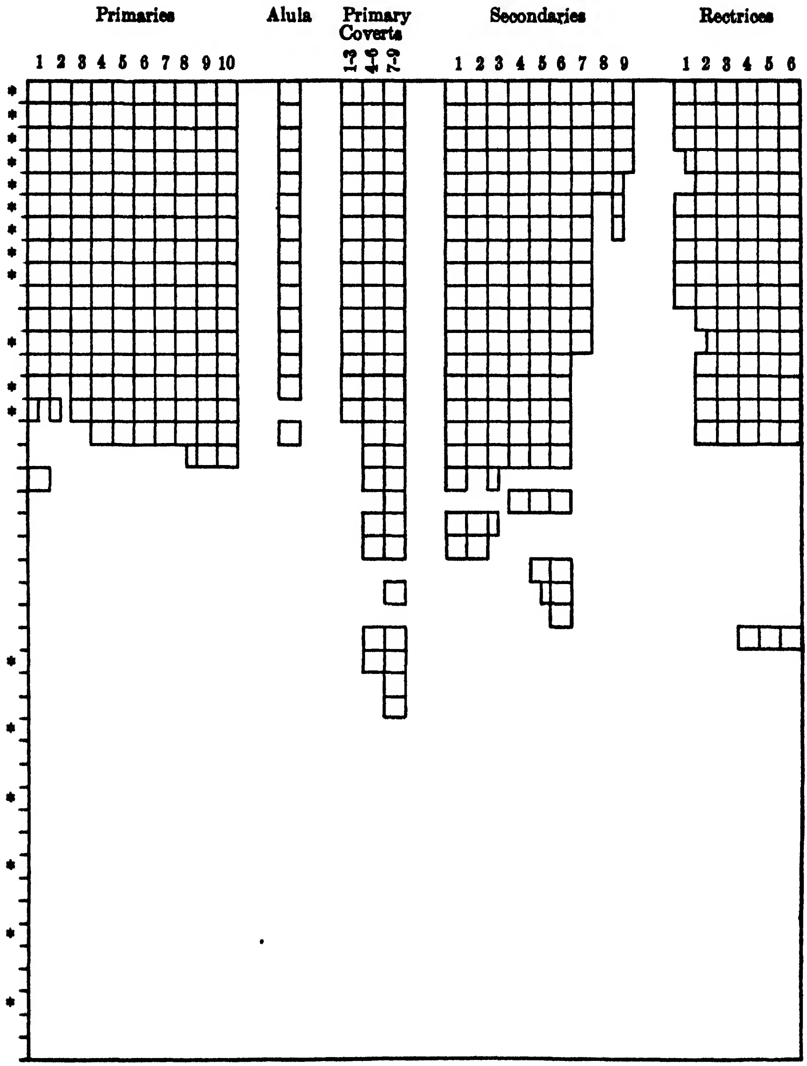

Fig. A. Juvenal feathers retained in forty-three first-year male Phainopeplas collected subsequent to the postjuvenal molt. Squares represent juvenal feathers retained; half-squares indicate retention on one side of the body only; each horizontal section, indicated by graduations on the left margin of the figure, represents a single individual. Primaries and rectrices are numbered beginning with the inner or most medial member; secondaries are numbered beginning with the outermost. Birds marked with an asterisk were collected in the coastal area, those unmarked in the desert areas (see text, p. 432).

Other wing coverts not shown in the graph, the marginals and the middle and greater secondary coverts, are nearly always replaced. The chief exceptions noted are two birds, low in replacement of other feathers, in which some juvenal greater secondary coverts are retained.

Variation in Postjuvenal Molt in Relation to Habit and Environment

In the graph those birds taken in the coastal district of southern California, the higher Mohave Desert at Victorville in San Bernardino County, and in central California are marked by an asterisk. All others come from the low desert regions of the Colorado River, Death Valley, Arizona, or Lower California. From the distribution on the graph it is seen that the group from coastal and central California, hereafter referred to as the coastal area, averages higher in juvenal feathers than the birds from the desert regions. Of the thirteen birds retaining all juvenal primaries, ten are from the coastal area, while birds from this area make up less than half the total represented on the graph. The five individuals from coastal and central California that have no juvenal feathers are arbitrarily arranged among the ten identically plumaged birds from the desert in the lower part of the graph. Practically the entire range of variation in completeness, then, may be found in each of the geographic areas under consideration, but the average of replacement is markedly different in the two.

Certain differences in habit and environment in coastal California contrasted with the desert regions require discussion. The first of these is migration. In the desert areas, as far as known, the species is resident the year around, with probably an increment of migratory individuals in winter. On the other hand, Grinnell (1915, p. 141) and Willett (1912, p. 91) state that Phainopeplas are summer residents in coastal and central California, most of them migrating southward in winter. Scattered individuals, failing to migrate, stay as far north as Contra Costa County and Modesto, Stanislaus County (♂, no. 1114, coll. Ralph Ellis, February 22, 1925). Dawson aptly suggests (1923, p. 562) that birds wintering in the north are induced to remain by favorable local food supply in the form of fruit or berries. Certainly migration in this species is erratic and often delayed in the fall until October, the birds returning in April or May.

Breeding takes place much earlier on the desert than to the north and west. On the desert at Palm Springs, Riverside County, I have taken fresh eggs on March 28 and 29, which dates in my experience mark

the height of the nesting season in that vicinity. Dawson (*op. cit.*, p. 555) states that nesting on the desert is in March and April with some birds beginning in late February (p. 562). Grinnell (1914, p. 187) reports nests with eggs along the lower Colorado River during the first half of April. In Lower California nesting evidently occurs at about the same time, since fully grown juveniles have been taken in the latter part of May. A juvenile, no. 48209, Mus. Vert. Zool., from San Felipe, Lower California, taken March 24, 1926, indicates a February nesting.

On the coast and in the north, nesting before May is rare. Willett (*op. cit.*, p. 92) reports a set of eggs taken by J. S. Appleton in late March in the Simi Valley, Ventura County. This nesting probably represents a pair that failed to migrate. Most of the nesting on the coast takes place in June and may extend into July. Young rarely are on the wing before the middle of June.

Dawson is of the opinion (*op. cit.*, p. 562) that after nesting on the desert the Phainopeplas migrate to the north and west in April and reside in coastal and central California probably without breeding, but mixing in with those that breed in this latter region. Seemingly this is mere supposition with no actual evidence to support it and would be an impossible situation for desert birds laying eggs in early April. In my experience I have been unable to detect any general exodus of breeding Phainopeplas from the deserts even in May when adults and young are common in these regions.

On the basis of the above data regarding nesting we may represent the height of the breeding season (eggs) on the desert as about April 1 and that in the north and west as June 1, approximately two months later. Young from sets of eggs laid about June 1 would not be independent of their parents until the middle of July, whereas birds reared on the desert would become independent about the middle of May. It is observable in many specimens at hand that the postjuvenal molt commonly extends in its later stages into the month of October and even early November in both geographic areas under consideration. The number of late molting immatures from the two areas is approximately equal. Consequently, the possible time available for molt extends from the middle of May to the first of November in the desert whereas it is two months shorter in the coastal region. Actually the time occupied by molt is not so great. In the coastal district the first stages of molt begin about August 1 or later in that month, the total time occupied being roughly three months. An unfortunately small number of July and August specimens from the desert precludes the possibility of stating a

definite date for the inception of molt in that region. On the basis of a few specimens, however, it appears to begin not two months earlier than on the coast but at least in some instances about one month earlier. The possibility is open, therefore, for a more extended molt and hence on the average a more complete molt in the desert areas, since molt is concluded at the same time in the two regions. Not only is the possible molt period longer in the desert areas but the birds often are older and better developed at its inception.

The effect of migration upon molt is not entirely clear. The coastal birds taken while they are still molting in early November possibly are individuals that would have failed to migrate. Those that do migrate in September and October may curtail the molt as a consequence of their migration, since it is generally assumed that birds do not molt while in migration. That there can be exceptions to this assumption, however, has been observed in shrikes that were found continuing their molt after migration and while on the wintering grounds. In making up the graph there was no way of determining whether winter-taken desert birds were raised locally or not. Hence, it is possible that some of the desert birds with many juvenal feathers might have been winter visitants from the coast with molt retarded due to September or October migration or other factors connected with the short time following the nestling stage in the area in which they were raised.

In the case of shrikes a preliminary study showed that the coastal race, *L. l. gambeli,* had a somewhat earlier molt period than desert birds. The desert group in this instance was made up largely of shrikes from the deserts of Nevada and the Owens Valley, which regions are characterized by very much later nesting seasons and earlier onset of winter temperatures than is the Colorado Desert where the desert Phainopeplas, for the most part, have been obtained. In later comparisons between *L. l. gambeli* of coastal California and *L. l. sonoriensis* of the Colorado Desert and Arizona area, it was found that *sonoriensis* had much more complete replacements than *gambeli.* The situation in these latter shrike populations parallels that in the two groups of Phainopeplas, although no migration occurs in the shrikes. Whether populations of *sonoriensis* like the desert Phainopeplas begin the molt earlier than does *gambeli* I do not have specimens to determine; very probably, however, they do.

THE POSTJUVENAL BODY PLUMAGE

The body plumage of females is a nearly uniform olivaceous mouse gray and is not distinguishable from that of adult females. In the first-year male the body plumage is highly variable. Individual body feathers may be entirely glossy black as in adult males, or entirely mouse gray as in females. Intermediate feather types appear in first-year males and range from black feathers with varyingly extensive grayish tips on the barbs to gray feathers in which the black is restricted to the bases of the barbs next the shaft, forming there a small black dot or stripe (see plate 9, figs. 13–20).

The male body plumage in the aggregate is made up of varying mixtures of these feather types or is pure black as in adults. No males with an entire body plumage of pure mouse gray feathers have come to hand, but several possessing an intermediate feather type deficient in black pigment, with many pure mouse gray feathers included, have been examined (see plate 8, figs. 2, 3, 4). In no case have I found juvenal body feathers retained and mixed in with postjuvenal feathers during the first year with the exception of the feathers of the crest. Thus the replacement of body feathers proper, in the postjuvenal molt, is as far as known always complete, and the apparent admixture of body plumage is the result entirely of the variety of feather types that may be produced during the course of this molt, not a mixture of feathers of various ages as in the wing and tail.

Two separate phenomena, then, contribute to the variable first fall plumage of the male, the one being incomplete replacements in wing and tail with essentially full or maximum black pigmentation, the other, complete replacement of body feathers with incomplete or submaximal black pigmentation. The first of these variables is essentially the same in the female and is probably not influenced by the gonads; but, as already indicated, it is associated with the time available for molt and with the age and vigor of the bird during postjuvenal molt, these in turn depending partly upon the variation in breeding season in different geographic areas. The second variable, that of pigmentation, must be associated with the gonads and probably is the result of a varying degree of development of the hormone-secreting tissues of the testis at the time of molt.

In domestic birds the experimental evidence for the control of sexually dimorphic plumage by gonadial hormones is reasonably complete. Domm (1927) and Juhn and Gustavson (1930) have shown in experi-

ments on extirpations and partial regenerations of gonads, and by injections of hormone extracts that the production of male and female types of feathers in the fowl are fully controlled by sex hormones, even to the point of changing both the structure and pigmentation of a single feather from one sex type to the other partway through the course of its development. In earlier experiments with ovariotomy in fowls, it appeared that hen feathering was the result of a simple suppression of cock feathering by a hormone of the ovary. Actually the results proved not to be capable of so simple an explanation. The problem is complicated in birds by the hypertrophy of the rudimentary right ovary which upon growth may be variable as to sexual character, frequently developing into a testis-like organ. To adopt Frank R. Lillie's (1927) views of the problem of control of sex characters, the ovary in both birds and mammals possesses a medullary hormone-producing portion similar to that of the testis which normally is not developed and is overshadowed by the cortical hormone-secreting tissue productive of the true female hormone. In the hypertrophy of a rudimentary right ovary one or the other of the two types of secreting tissue may gain partial or complete ascendancy. Lillie further adduces evidence to show that feather germs are asexual, that is, they are the same in the two sexes or are equipotential. In different species, however, they are varyingly responsive to gonad stimulation. Thus it is possible that in certain species the ovarian medullary hormone induces considerable effect while the testicular hormone does not, whereas in other species it is the male hormone that induces the principal change from an undifferentiated condition. In the case of feather germs there is no evidence to indicate that intersexual conditions or sexual differentiation result from the chromosome-gene complex within the cells of the feather germ itself.

Experimental methods have been open to criticism from the standpoint of the naturalist because of the artificiality of the conditions attending the experiments. It appears, however, that in the analysis of Phainopepla plumage there is an opportunity to observe a natural experiment which under perfectly normal conditions seems to corroborate certain of the principles discovered by the experimentalists in the laboratory. By studying a group of immature Phainopeplas which have been preserved at varying stages of the body molt and with varying appearance of black pigmentation, we have in a sense a continuous picture of the period when the testis is apparently attaining full hormone-secreting function.

One of the facts determined is that many young males produce during the early stages of the postjuvenal molt mouse gray body feathers whereas later in the same molt they produce only black feathers. A number of examples have been examined in which a few gray feathers on the breast are fully grown and gray while those still in the sheaths and often intermingled with the gray feathers are black or partly black. Further, it has been noted that the sporadic replacement of body feathers that constitutes the prenuptial molt in February and March always produces black feathers. In discussing the order of replacement of body feathers at the postjuvenal molt, it was stated that the central feathers of each lateral division of the ventral tract tend to molt first, producing a stripe of new feathers on either side of the breast. Not infrequently it happens that these feathers are gray and those medially and laterally, being produced later, are black. This results in a pattern of breast coloration illustrated in plate 8, figure 3.

Many males, however, produce black feathers at the very onset of the molt and attain an entirely black body plumage, while other individuals never attain any totally black feathers during the first fall. There results, then, a seemingly endless variety of pied patterns because of the variable effectiveness and time of the beginning of testicular influence and because of somewhat variable sequence of body feather replacement.

The mechanism for the production of male pigmentation in the Phainopepla may be supposed to be a hormone elaborated in the testis, as in domestic fowls, and stimulating in this species the sexually equipotential feather germs to lay down large quantities of melanin. That the mouse gray plumage is essentially an asexual stage is suggested by the identity of the sexes in the juvenal stage and the near identity of juvenal with female and gray immature feathering, at least as regards pigment (the structural differences in the juvenal and postjuvenal feathers are noted on page 427). It is unlikely that a change as the result of uncompleted development takes place within the dormant feather germ between the times that postjuvenal and adult feathers are formed. Before the postjuvenal molt the skin structures are completely differentiated and the region about the follicles adult in appearance. In other words, there seems to be no reason to believe that the change in feathers grown subsequently from the same follicle after the juvenal feathering is due to a local change in the follicle, but rather that it arises from a modifying factor spread throughout the body, such as the appearance of a hormone in the circulation.

It is apparent that the male hormone is not present in sufficient amounts to stimulate full pigmentation in many cases by the time of the postjuvenal molt. The gonads evidently are at a critical stage of development at this period in that they are just reaching in their production the threshold stimulus or adequate dosage for the feather germs of this particular species. That different feather tracts require different amounts of hormone to induce pigmentation is evident. I have already mentioned the practically infallible appearance of black pigment in the postjuvenal wing and tail feathers, these feathers often being associated with postjuvenal mouse gray feathers. The wing and tail feathers fail to produce black pigment only in the tips of the greater secondary wing coverts and upper tail coverts, and occasionally in some of the inner secondaries. The deficiency of melanin in these tips is more pronounced in individuals with bodies predominantly gray. It follows that the body feathers require more stimulation to produce solid black areas than do wing and tail feathers. Some birds are available that are growing black wing coverts and gray body feathers at the same time. Further, I have found that black pigment is produced somewhat more readily on the back than on the ventral surface, the two areas being identical in coloration in the adults; the difference is illustrated in cases wherein feathers of the breast and back, growing simultaneously, are gray and black respectively. Often, however, there is little difference in the amount of gray in breast and back after the molt is finished.

These differences in the feather tracts, as well as the various types of individual feather patterns produced, may be interpreted more fully in the light of Lillie and Juhn's recent work (1932) on the threshold stimulus and growth rate in the feather germs of fowls. From their experimental evidence it appears that the growth rate of the contour feathers of the dorsal tract (saddle) is less than for those of the ventral region of the body and that, associated with this, additions of female hormone induce changes in pigmentation with lower dosages (lower threshold) in the dorsal region than in the ventral areas. It would appear that the slight differences in pigmentation on dorsal and ventral surfaces of some immature male Phainopeplas is associated with a similar differential growth rate. The growth rate of the wing and tail feathers, particularly of the major flight feathers, appears to me to be relatively rapid; but without actual determination of this rate of growth I can make no definite statement. It is possible, however, that the very low threshold in these feathers is in part the result of a considerably different feather structure, the germs perhaps having a different sus-

ceptibility to the hormone aside from the factor of growth rate. Nevertheless, it is to be observed that within the wing, the coverts and inner secondaries that grow faster than do the outer secondaries and primaries are the most given to submaximal pigmentation as shown in their light-colored tips.

The application of the threshold growth-rate principle to the production of pattern in the individual body feathers of Phainopeplas likewise seems justified. In the fowl Lillie and Juhn (*op. cit.*) demonstrated that the proximal parts of the barbs and the rachis have a slower growth rate than the distal parts of the barbs. A gradient of threshold and growth rate extends along each barb. In instances of low concentration of hormone in the blood, feathers appear with altered pigmentation only in the rachis and bases of the barbs. With increased dosages this pigmented region spreads distally along the barbs until with full dosage completely altered feathers result. A striking parallel exists in the body feather patterns of young male Phainopeplas. The selected series of intermediate types between gray and black body feathers shown in plate 9, figures 13–20, represents what evidently are successive stages in pigmentation and hence stages in hormone influence along the growth-rate gradients of the barbs. Some significant observations may be made in this connection: firstly, the male hormone seems to act in a manner entirely comparable with that of the female hormone of the fowl in relation to growth rate gradients which by inference we may assume to be present in Phainopepla feathers; secondly, the similarity in pattern types of individual feathers in Phainopeplas and those of the experimental fowls with insufficient hormone dosage strengthens our hypothesis regarding the causes of variation in pigmentation of immature male Phainopeplas; and thirdly, the principles outlined in Lillie and Juhn's work apparently can be applied to the feathers of distantly related types of birds.

Unfortunately the gonads of the Phainopeplas studied were not saved and so are not available for histological examination, which would admirably serve to check upon certain of the hypothecations the author has set forth. It is logical to suppose, nevertheless, that birds more recently hatched are less likely to have reached a development of the testis required for the production of black feathers at the postjuvenal molt. Since incomplete wing and tail molts probably depend, as before stated, upon general development and vigor at the inception of and during the molt as well as upon the time available for molting, it is not surprising to find incomplete molt and incomplete pigmentation, the result of lagging

or incomplete development of the testis, frequently associated. They are, however, not at all perfectly correlated, which points again to the more or less independent causes for variable molt and variable pigmentation. Absence of a high correlation is attested by several birds with incomplete secondary molt and black bodies, and others with complete wing and tail molt and partly gray bodies. Comparing the geographic areas, birds that have been raised in the coastal area are younger on the average when they begin the molt and hence, besides having less time to molt, may possess less general vigor to complete the molt and at the same time will often be less developed sexually than individuals reared on the desert. Of the forty-three first-year males shown in the graph, 50 per cent of the desert-taken birds have pure black body plumage while only 33 per cent of the coastal birds are pure black.

SUMMARY

Phainopepla nitens exhibits a wide range of individual variability in completeness of the postjuvenal molt. The range of variability is greater than in North American representatives of the genus *Lanius*, previously studied in this connection, and far exceeds that of most other passerine birds. This variability is here represented in graphic form (fig. A).

Geographic as well as individual variation in completeness of the postjuvenal molt has been found within the one subspecies *P. n. lepida*. Factors that pertain to the two geographic areas concerned and that influence completeness of molt are the date of hatching and possibly also the presence or absence of migration.

The variable body plumage of male birds of the first winter is not the result of incomplete postjuvenal body molt but of incomplete deposition of black pigment during that molt.

Evidence to indicate that the hormone-producing tissue of the testis is variably developed at the time of the postjuvenal molt and hence variably capable of stimulating black pigment deposition is discussed. Incomplete pigmentation and incomplete molt are probably dependent upon different physiological conditions and hence are not always associated.

Apparent differences in the threshold stimulus of the hormone necessary to induce black pigmentation in feather germs of different tracts are described. Some of these differences may be explained by the principle of correlation of hormone threshold with rate of growth. Patterns of partly black body feathers may be attributed to differences in threshold and growth rate in the various parts of the individual feather.

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EXPLANATION OF PLATES

PLATE 8

Study skins of *Phainopepla nitens* illustrating plumage types. All approximately × ⅝. Numbers of specimens are those of the Museum of Vertebrate Zoology unless otherwise specified.

Fig. 1. Adult male, ventral view, showing entirely glossy black body plumage; no. 27456, Dunlap, Fresno County, California, September 30, 1916.

Fig. 2. First-year male, ventral view, showing white tipped postjuvenal under tail coverts and a few gray tipped body feathers; no. 13496, Riverside Mountain, Colorado River, Riverside County, California, March 17, 1910.

Fig. 3. First-year male, ventral view, showing patches of gray feathers on either side of breast; no. 30063, San Lucas, Monterey County, California, November 18, 1918.

Fig. 4. First-year male, ventral view, showing predominantly gray body plumage; no. 36906, Victorville, San Bernardino County, California, December 27, 1904.

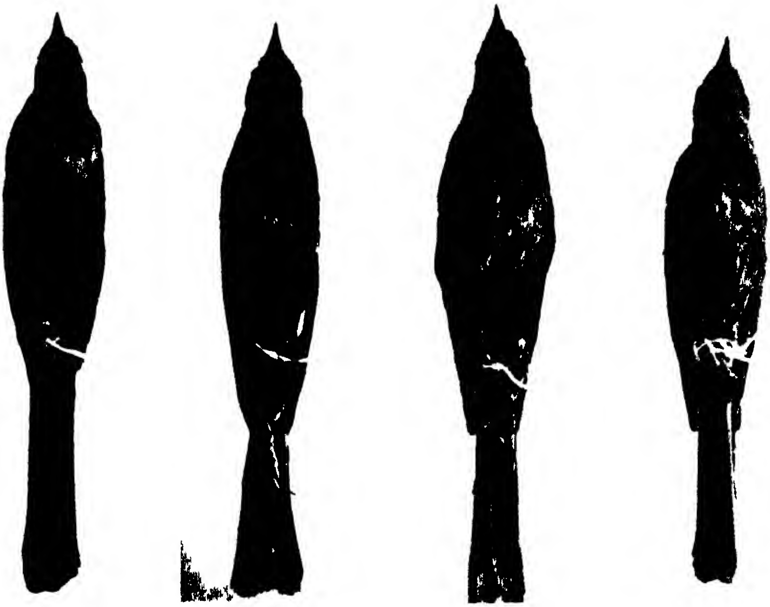
Fig. 5. First-year male, dorsal view, showing white edgings of postjuvenal inner secondaries and coverts; same individual as shown in figure 3.

Fig. 6. Adult male, side view, showing black wing coverts (high lights on coverts give a false appearance of minute gray edgings); same individual as shown in figure 1.

Fig. 7. First-year male, side view, showing white margins on postjuvenal wing coverts and entirely black body plumage; no. 193, coll. A. H. Miller, Bard, Imperial County, California, January 5, 1925.

Fig. 8. Adult female, side view, showing wing markings and pure gray body plumage; no. 13490, Mellen, Colorado River, Mohave County, Arizona, February 28, 1910.

Fig. 9. Juvenal male, side view, showing similarity of color and markings to those of adult female; no. 36878; Pasadena, Los Angeles County, California, August 31, 1895.



1 2 3 4

5 6 7 8 9

PLATE 9

Breast feathers of *Phainopepla nitens*, × 1¼, illustrating appearance and distribution of pigment in the individual feather. All feathers extracted from the left sternal region of the ventral feather tract. Numbers of specimens from which feathers were taken are those of the Museum of Vertebrate Zoology unless otherwise specified.

Fig. 10. Adult male; no. 27456, see plate 8, figure 1.

Fig. 11. Adult female; no. 36880, Pasadena, Los Angeles County, California, September 27, 1896.

Fig. 12. Juvenal male; no. 36878, see plate 8, figure 9.

Figs. 13–20. Postjuvenal breast feathers of first-year males arranged in order to show patterns of transition stages between gray and black feather types.

Figs. 13, 14. No. 36881, Pasadena, Los Angeles County, California, October 15, 1896.

Figs. 15–17. No. 36906, see plate 8, figure 4.

Fig. 18. No. 26325, Varain, Mariposa County, California, November 30, 1915.

Figs. 19, 20. No. 193, coll. A. H. Miller, see plate 8, figure 7.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